UNITED STATES DEPARTMENT OF LABOR
Frances Perkins, *Secretary*
BUREAU OF LABOR STATISTICS
Isador Lubin, *Commissioner*

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Employment and Earnings in the Engineering Profession 1929 to 1934

By
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under the direction of
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Bureau of Labor Statistics

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UNITED STATES DEPARTMENT OF LABOR,
BUREAU OF LABOR STATISTICS,
Washington, D. C., June 3, 1940.

The SECRETARY OF LABOR:

I have the honor to transmit herewith a report on Employment and Earnings in the Engineering Profession. This report was prepared by the Bureau of Labor Statistics at the request of American Engineering Council.

ISADOR LUBIN, *Commissioner.*

Hon. FRANCES PERKINS,
Secretary of Labor.

PREFACE

In the engineering profession there are not only certain similarities in the qualifications required in the various branches of activity but there is also a great degree of specialization. Once a field of specialization has been selected, there is relatively little movement between the various engineering groups.

This study not only presents a picture of the broad profession known as engineering, but also of the major professional classifications which include civil, mechanical, mining, chemical, and electrical engineering. It deals with the changes in employment opportunity and income within the engineering profession over the period from 1929 to 1934. It gives a cross-section of a number of professional groups at a given point in time. It also portrays the ebb and flow of their fortunes over a critical period. The extent of the coverage is a manifestation of the interest of individual engineers in the fortunes of their profession and of the whole-hearted cooperation offered the Bureau of Labor Statistics by the engineering societies and the deans of engineering schools.

An adequate summary of the several analyses can hardly be more than briefly presented in the first pages of this report. Among the high lights are the following:

1. The number of engineers increased by more than 25 percent between 1929 and 1934. The number of engineering jobs increased by less than 5 percent.

2. In both 1932 and 1934 substantial numbers of engineers were unemployed. In the worst period approximately one-tenth were unemployed at the same time.

3. A far larger proportion, about one-third of the total number, experienced unemployment at one time or another from 1929 to 1934.

4. Under these conditions entry into the profession was unusually difficult. Large numbers of the graduates of the classes of 1930–34 were unemployed for considerable periods. Many were forced into nonengineering employments and entrance salary rates were severely depressed.

5. Despite this fact, three-fifths of the graduates of 1930–34 did have engineering jobs at the close of 1934.

6. Older engineers were less likely than younger engineers to lose their jobs. When they did so, however, the older engineers had a more difficult time in getting themselves rehired.

7. The small increase in the total number of engineering jobs between 1929 and 1934 is entirely due to an increase in public employment. Employment with private firms declined 8.2 percent.

8. The average annual earnings of all engineers declined from $3,412 in 1929 to $2,286 in 1934, a decline of one-third. This reflects lower rates, loss of employment and poorer types of employment.

9. The average rates paid for all engineering services declined from $289 per month to $210, a decrease of 27.3 percent.

10. At any time there is a wide range in the annual earnings of engineers. Thus, in 1929, 10 percent earned less than $1,878 while the highest 10 percent earned more than $7,466.

11. The average earnings of engineers increased with age up to the group 60 to 65 years of age. The initial increases are relatively rapid.

12. The earnings of the lowest 10 percent of the engineers of comparable age do not advance significantly after 40 years of age, and are little if any higher than the usual average earnings of groups 3 or 4 years after graduation.

13. While differences in earnings among the various classes of engineering are quite pronounced, the striking characteristic of entrance rates into the profession is their similarity as between different classes of engineers and as between different types of work.

This study is the first of its kind made by the Bureau of Labor Statistics. With the recent establishment of the Occupational Outlook Service in the Bureau, similar studies will be made in the future.

It is obvious from this study that problems of earnings and employment opportunity are by no means confined to wage workers and that the Department of Labor must be concerned with other groups whose income depends upon the sale of their services. The "labor problem," if it ever was primarily the problem of a special class in the community, has become in one way or another the problem of virtually all groups.

While this study should have an important place in the literature of trends of social forces in the United States, it will also necessarily serve more immediate practical forecasting purposes. Young persons making a choice of a profession must project the probable future advantages of the several alternatives that may be open to them. In this connection, the results of the present study must be used with great caution.

For example, it cannot be too strongly emphasized that the present average earnings of a group who have been in a profession for 15 years is not a measure of the probable earnings 15 years hence of a group entering the profession this year. The group will, of course, be subject to the usual vicissitudes of changing price and wage levels. Furthermore, the present earnings of any two age groups reflect not only present conditions but also carry into the present the background of conditions prevailing when each group entered the profession. If there were comparatively few professional workers 15 years ago in a field in which production has since expanded rapidly, it follows that there will be comparatively few people with long experience relative to the present demand. The present earnings of this group are likely to reflect this scarcity, and to carry a premium that will not continue when the supply of new entrants becomes relatively large. Forecasts of relative earnings and opportunities must, there-

fore, involve forecasts of supply and demand. This the present report has not attempted, except as a knowledge of changing conditions in recent years may furnish a starting point for cautious projection.

The report was prepared by Andrew Fraser, Jr., under the direction of A. F. Hinrichs, Assistant Commissioner of the Bureau. The clerical work for the survey was directed by Abner C. Lakenan. The machine tabulation work was conducted by J. Paul Kingston under the direction of John J. Mahaney, Chief, Machine Tabulation Division.

ISADOR LUBIN,
Commissioner of Labor Statistics.

Bulletin No. 682 of the
United States Bureau of Labor Statistics

Employment and Earnings in the Engineering Profession, 1929 to 1934

Summary

This report on employment and earnings of professional engineers deals with information collected in 1935 by the Bureau of Labor Statistics, at the request of American Engineering Council, in order to determine the effects of the depression upon professional engineers during the period 1930–34.

Scope and Method

The data were collected by means of a mail questionnaire, a copy of which was sent to each of 173,151 professional engineers. This list may be considered as representative of every phase of professional engineering activity, in that it was compiled through the cooperation of most of the engineering societies in the country, with additional names furnished by 32 State boards of engineering examiners and the deans of 156 engineering schools. The net number of usable returns was 52,589, or 30.4 percent of the original mailing list.

The 52,589 returns embraced 33,841 older engineers who reported that they were professionally active prior to 1930. The remaining 18,748 returns included younger engineers who had entered the profession in the period 1930–34.

The 33,841 returns from the older engineers averaged 15 percent of the 226,136 technical engineers reported in the 1930 census. On a regional basis, and separately for four groupings of professional classes, the age composition of the returns closely approximated the 1930 census data. Comparison of the 18,748 returns from younger professional engineers, which covered primarily men with first degrees in engineering, with the corresponding Office of Education data for the period 1930–34 shows that approximately 32 percent of all such engineers furnished information to the Bureau.

The two parts of the sample obtained in this survey can be considered as representative of all professional engineers in the country. They are also representative of the profession even in combination after adjustment had been made for the disproportion in the returns received from older and younger engineers whenever a cross section of the profession was required for the years 1932 and 1934.

The Growth of the Engineering Profession, 1910 to 1934

To understand better the problems faced by the profession in the period 1930–34, special consideration was given to the growth of the profession. This analysis shows: that for the decade 1910–19, the census indicates an absolute increase in technical engineers from 88,744 to 136,080, or 53.3 percent. In the decade 1920–29 the increase was from 136,080 to 226,136, or 66.2 percent. From 1930 to 1934, reports made in the present survey indicate a growth of 26.4 percent, or in absolute numbers in the sample from 33,841 in 1929 to 42,787 in 1934. Despite similarity in annual influx the data reveal that the rate of increase of technically trained engineers during the depression was slightly less than it had been in the decade of the 1920's. For the latter period, the compound rate of growth apparently was 5¼ percent per year as against a compound rate of growth of 4¾ percent per year in the period 1930–34.

Further comparison of the two periods shows a marked change in the source of supply of engineers. In the depression years the colleges were supplying as many engineers with degrees as were supplied in the 1920's from all sources. In the 1920's, a substantial number of entrants to the profession were nongraduates with an incomplete college course. This raising of educational standards appears to be definitely related to the change in the relationship of the demand for professional services to the supply of trained engineers. What this change meant, and also that which occurred in the increase in the number of professional engineers in terms of employment and unemployment, is developed in this report.

Educational Qualifications of Professional Engineers

Although the reports in the survey embraced a substantial number of men who had obtained professional engineering status without formal engineering education, analysis reveals that a first degree in engineering is almost a prerequisite to obtaining professional status. Insistence upon rigid engineering education as a prerequisite to engineering experience is further evidenced by the fact that all but a very small proportion of the agricultural, ceramic, and chemical engineers had college degrees. However, as many as 17.3 percent of the civil engineers were not college graduates.

Despite the fact that first degrees predominate in all professional classes, the extent of educational specialization showed considerable variation. Thus, while first degrees in engineering were reported by 63.4 percent of the architectural engineers, the highest proportion (77.3 percent) was found in the case of the ceramic engineers. Instances of transfer of engineers from their original course of specialization to other fields of activity were negligible.

Although the data also reveal a distinct growth in postgraduate training in engineering, the ratios of engineers with postgraduate training show marked differences in the demand for a higher degree of educational specialization and more elaborate training. In the case of chemical engineers, the percentage was as high as 15.7. The percentage for agricultural engineers with graduate degrees was almost equally large. Among the other seven professional classes, the proportions of postgraduates ranged from 3.5 in the case of industrial engineers to 9.3 for both ceramic and mining and metallurgical engineers.

Employment in the Engineering Profession, 1929 to 1934

Supply and demand for engineering services, 1929 to 1934.—Over the 5-year period ending December 1934, the number of persons in, or trained for, the engineering profession increased by 25.3 percent.[1] On the other hand, opportunities for engineering employment increased only 4.4 percent. The result was a large amount of unemployment and intense pressure to find nonengineering work. Thus, the proportion of engineers engaged in nonengineering employments increased from 6.3 percent in 1929 to 14.1 percent in 1934. The proportion unemployed increased from 0.7 to 8.5 percent.

Had it not been for the large increase in the employment of engineers by public authorities, the effect of the depression on the profession would have been even more disastrous. Thus, private engineering employment decreased by 11.8 percent from 1929 to 1932, and despite some increase from 1932 to 1934, it was still 8.2 percent below the 1929 level at the end of the 5-year period 1930–34. On the other hand, there was a 46.8 percent expansion in public employment of engineers. The absolute increase reported in private engineering employment between December 1932 and December 1934 was only half of that obtaining in engineering employment with public authorities. Relative to the numbers so employed in 1932, the rate of increase in public engineering employment was almost five times as great as that in private engineering employment.

Over the period 1930–34 the increase in the number of engineers among the several professional classes ranged from 17.6 percent for mining and metallurgical to 62.5 percent in the case of chemical and ceramic engineers, but in no professional class did total engineering employment keep pace with the growing number of engineers.

[1] This increase of 25.3 percent differs by 1.1 percent from that of 26.4 percent noted in the discussion of the growth of the profession. This difference is explained by the fact that in tabulating the data on employment status homogeneity of the sample of older and 1930–1932 engineers was maintained. That is, in the case of the former, only those reporting for the 3 years 1929, 1932, and 1934 were used; in the case of the latter, only those reporting for the 2 years 1932 and 1934 were included. While the difference between the 2 percentages does not materially affect the analysis, it does indicate that the percentage of engineers eliminated from the tabulations was small.

Furthermore, the opportunities for private engineering employment differed markedly among the professional classes. Thus, over the 5-year period, private engineering employment increased by more than a third for chemical and ceramic engineers. Employment of electrical, mining and metallurgical, and mechanical and industrial engineers remained relatively constant. In the case of the civil engineers, there was a decrease of about one-third in private engineering employment.

All professional classes participated in the increases in employment of engineers by public authorities. The sharpest increases occurred in the period 1932–34. The most pronounced increase occurred among civil engineers. The proportion of this group employed by public authorities increased from 40.0 percent in 1929 to 48.5 in 1934.

In 1929 private engineering furnished by far the greatest employment for engineers. For civil engineers this covered 54.3 percent. There was a range of from 80.6 to 87.3 percent among the other four professional classes. By December 1932 private engineering among civil engineers had dropped to 37.6 percent and by December 1934 to 31.8 percent. There was also a continuous decline in this type of employment among electrical engineers; only 63.1 percent reporting such employment in December 1934. There was only a slight improvement over 1932 for the remaining professional classes. In 1934 these three averaged 69.1 percent.

Nonengineering employment increased sharply from 1929 to 1932 and in equal measure for all professional classes, absorbing many more engineers than did public engineering, in which employment also increased. But despite the fact that the proportions of all engineers in nonengineering employment rose from 6.3 percent in 1929 to 12.0 percent in 1932, there was an even larger increase in unemployment. This situation was common to all professional classes. Between December 1932 and December 1934 there were further increases in nonengineering employment for all professional classes, although the increases were not so great as between 1929 and 1932. Unemployment declined for all professional classes, except for civil engineers.

Of all engineers who reported as being professionally active prior to 1930, only 46.2 percent were in the employ of private firms in 1934; in 1929, 62.2 percent were so engaged. Federal Government employment provided for 10.1 percent in December 1934; in 1929, this field gave employment to only 5.3 percent.

Over the period 1930–34 there was a remarkable stability in the number of engineers classified as independent consultants, and those engineers engaged in the teaching of engineering subjects. This was also the case for those in the employ of State, county, municipal, and other public authorities, especially if considered together.

Despite the fact that 5,003, or 16 percent, of the reporting engineers active in the profession before 1930 suffered a loss of private engineering employment by 1934, some 3,112, or 18 percent, of the new entrants found engineering work with private firms. The increase in public engineering employment was shared by both older and younger engineers.

Employment in relation to engineering experience.—Analysis of the employment data in relation to advancing age and experience shows that private engineering predominates as a first field of employment for recent graduates. With advancing age, the decline in the proportions so reporting was very marked indeed.

For civil engineers, public engineering employment follows in importance after private engineering employment as first fields of employment opportunity. By contrast, the two most important sources of employment after private firms for recent graduates in the other professional classes were teaching and nonengineering.

Among all professional classes, both State and county government employment and that with municipal and other public authorities constituted both training grounds and fields of final employment. By contrast, Federal Government employment was virtually a field of final employment or one suited for men with years of experience.

Independent consulting was practically nonexistent as a type of employment for recent graduates.

Employment in relation to type of education.—Engineers, irrespective of the type of education they have received, are overwhelmingly dependent upon private industry for employment. Only among postgraduates did private firms employ as little as one-half. For first-degree engineering graduates, State and county work followed in importance after private-firm employment (7.3 percent). This proportion differed but slightly from those reporting nonengineering work or employment with municipal and other public authorities.

Among those with postgraduate training, no less than 29.4 percent were engaged in teaching. Of the 1,729 engineers engaged in the teaching of engineering subjects, 60.7 percent were first-degree engineering graduates and 31.8 percent were postgraduates. Nonengineering graduates and engineers who had not completed a college course embraced the same proportions (3.3 percent). The next highest percentage of 0.8 referred to noncollegiate technical school engineers.

The analysis makes it evident that experience and not education was the important criterion for entry into independent consulting work.

Fields of engineering activity.—In regard to fields of engineering activity, chemical and ceramic engineers were more dependent upon

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manufacturing industries for their employment than any of the other four professional classes. Not less than 66.6 percent of the older engineers were so engaged in December 1934. For all three age groups, 4.5 percent were employed by public utilities and 5.7 percent were in extractive industries. Transportation and construction work were practically nil as fields of engineering activity for chemical and ceramic engineers. Public engineering included 8.5 percent, while 11.6 percent were engaged in teaching and other forms of personal service. In general, mechanical and industrial engineers closely paralleled the distributions noted for chemical and ceramic engineers.

Both mining and metallurgical engineers and electrical engineers had alternative fields of engineering activity to manufacturing, namely, extractive industries and public utilities. With advancing age, the proportions of these professional classes in manufacturing steadily declined, while those reported for both extractive industries and public utilities steadily increased. In the remaining fields of engineering activity, these two professional classes show similar distributions.

Civil engineers predominate in the construction fields of private industry and public employment, while their opportunities in other fields were very low. Thus, in manufacturing only 5.4 percent of their older engineers were so employed, in public utilities 3.8 percent, in extractive industries 2.7 percent, and in transportation 4.3 percent. The 6.9 percent reporting in personal service was relatively the lowest of the five professional classes.

Types of engineering work.—Consideration of the distributions of engineers by types of engineering work shows that civil engineers predominate in construction and that this is the predominant type of work for civil engineers. For all other classes of engineers the most important type of employment was "operation"—production, maintenance, etc., under supervision. The next most important type of employment was design and research.

Sales work is more important as a source of employment to electrical and mechanical and industrial engineers than to other classes of engineers.

As would be expected, general administration and management covered a higher proportion of younger mechanical and industrial engineers than are reported by any other professional class. Among the older engineers reporting, however, there was little difference between the various classes in the proportions so engaged.

Consulting and teaching both presented the same characteristics. First, they did not offer a wide range of employment to younger engineers, and second, there was a close similarity in the proportions of all older engineers engaged in these two types of work.

Conditions of Employment in the Engineering Profession

Analysis of reports furnished by engineers in engineering work in December 1934 shows that 68.4 percent of all professional engineers used personal contacts and recommendations to obtain their jobs. Those who used this medium, together with those who obtained their positions through the civil service, formed nearly four-fifths of all reporting.

The degree of economic security among professional engineers, as evidenced by possession of an employment contract covering some period of time, or by pension privileges, was negligible.

Unemployment in the Engineering Profession, 1929 to 1934

Unemployment at end of 1929, 1932, and 1934.—Between the ends of 1929 and 1932, the percentage of engineers who were unemployed increased from 0.7 to 10.1. At the end of 1934 the percentage was 8.5. There was slight variation in the proportions of unemployment among the various professional groups for each of the three periods. Thus, in 1932, the range was from 8.6 percent for the chemical and ceramic engineers to 10.7 for mechanical and industrial engineers. In 1929, while 2.0 percent of the mining and metallurgical engineers reported unemployment, the range for the remaining professional classes was only from 0.5 to 0.7 percent. So also in 1934 there is a narrow range for all professional groups, except civil engineers. In their case the proportion unemployed increased from 10.0 to 10.2 percent.

As of December 31, 1929, the percentage range of unemployment was from 0.4, in the case of the youngest engineers, to 1.9 for engineers 48 years and over. By December 1932 unemployment had increased markedly for all age groups. Unemployment was least (8.0 percent of the total) for engineers 31 to 40 years of age in 1932 (33 to 42 years of age in 1934); it rose, however, to 10.9 percent among the oldest engineers, those over 50 years of age in 1932.

By December 1934 many of the older engineers were still unable to obtain work, and there is a very strong presumption that the preference in new hirings was given to the younger men. Thus, unemployment among those who graduated from 1925 to 1929 was cut from 10.6 percent in December 1932 to 7.0 percent in December 1934. Declines also occurred between these periods among those who had graduated from 1930 to 1932, and those 41 to 50 years of age in 1932. But the proportion of those over 50 in 1932 reporting unemployment rose from 10.9 percent in December 1932 to 11.5 percent in December 1934.

Among the several professional classes, with the possible exception of chemical engineers, unemployment at all three dates was higher for those who were 53 years of age or over in 1934 than for the younger men who entered the profession in the period 1925–29.

Incidence of unemployment, 1930 to 1934, inclusive.—More than 34 percent of all the engineers reporting were unemployed at one time or another in the period 1930–34, as against about 10 percent who were unemployed on December 31, 1932. For all graduates 33.9 percent experienced unemployment. This percentage differs but slightly from the general average of 35.4 and 35.6 percent, respectively, for engineers who did not complete a college course and for engineers with a noncollegiate technical-school training.

In all professional groups there appeared an age beyond which there was apparently a common risk of unemployment. For civil engineers it was 43 years of age, whereas for electrical, and mechanical and industrial engineers it occurred after 33 years of age. There appears to have been no greater incidence of unemployment among the engineers 53 years of age and over than there was among those 43 to 52 years of age.

At all ages, civil engineering showed the greatest extent of unemployment. Thus, of this group graduating in 1930 to 1932, 59.7 percent reported unemployment at some time during the 5 years covered. The next highest percentage, 54.7, was found among electrical and mining and metallurgical engineers. Among civil engineers graduating prior to 1914, approximately 27 percent reported unemployment, whereas approximately 24 percent of the mechanical and industrial engineers, and mining and metallurgical engineers so reported.

Periods of unemployment, 1930 to 1934, inclusive.—For the country as a whole, the median period of unemployment for engineers who were college graduates was 12.2 months. For engineers who did not complete their college course it was 16.3 months, and for those with a noncollegiate technical-school training, it was 17.3 months.

The average length of the period of unemployment increased with age. When the older engineers became unemployed, unemployment lasted longer than it did with the younger engineers. Thus, the median period of unemployment for engineers graduating in 1925–29 was 12.1 months, whereas the median for those graduating prior to 1905 was 23.1 months.

This rapid increase in the length of the average period of unemployment holds also with reference to all of the separate professional classifications. In the case of electrical engineers, the average rose from 14.1 months for those men 33 to 42 years of age to 25.3 months for those who were over 53 years of age. For mechanical and industrial engineers, the increase was from 15.2 to 22.2 months, and in the case of civil engineers from 12.9 to 22.9 months.

The influence of regional location on unemployment was practically negligible, whether considered from the point of view of differences in incidence or of severity of unemployment.

Public relief among professional engineers, 1929 to 1934.—At no time was direct relief extensive among professional engineers, but the development of work-relief programs after 1932 was important. In fact relief work on work-relief projects was the main source of assistance to those who remained unemployed. Thus, on December 31, 1932, when slightly more than 10 percent of the engineers were unemployed, only 0.7 percent were on work relief. Two years later nearly 5 percent of all engineers were on work relief, which was approximately half of the total number of engineers unemployed at that time.

The reports for December 31, 1934, show striking differences in the extent of work relief as between civil engineers and the other professional classes. At that time 6.2 percent of all civil, agricultural, and architectural engineers were on work relief as compared with only 2.2 percent of all the other professional classes combined.

Among engineers with an incomplete college course, 19.6 percent of the civil-engineer group reported some work relief, whereas only 7.5 percent of those in the other professions considered together so reported. Among college graduates, work relief was reported by 16.8 percent of the civil-engineer group and by only 10.9 percent of the mining and metallurgical engineers. For the other professional classes, the percentages were 8.3 for both electrical and mechanical and industrial engineers, and 6.6 for chemical and ceramic engineers.

In all professional classes, age was an important factor in the frequency of work relief. Thus, there was relatively little difference as regards the frequency of work-relief experience between those graduating in 1930–32 and those graduating in 1933–34. By contrast, the percentage of civil engineers and electrical engineers who reported work relief was only half as large among those graduating prior to 1915 as among those graduating in 1930 or later years.

The median period of work relief was approximately 5 months. Essentially, the periods were the same for both civil engineers and mechanical engineers, though the average period was perhaps shorter in the case of electrical engineers. In more than four-fifths of the cases, those who reported a period of work relief also reported a period of unemployment.

Patent Privileges of Professional Engineers

In general, there appears to be little restriction upon professional engineers with regard to patent rights to inventions made by them. The extent of restriction, however, depended largely upon the engineer's field of employment and the type of work in which engaged.

Earned Annual Incomes of Professional Engineers, 1929 to 1934

Earned Annual Incomes from all Sources in 1929, 1932, and 1934

Incomes of engineers without regard to age.—In 1929, 50 percent of the 30,032 reporting engineers earned more than $3,412, and 50 percent earned less than that amount. Twenty-five percent earned more than $5,012, and 10 percent had incomes in excess of $7,466 per annum. On the other hand, 25 and 10 percent of the engineers earned, respectively, less than $2,509 and $1,878 per year.

Also in 1929 and without regard to the age distributions of the different classes, 10 percent of the mining and metallurgical engineers earned more than $9,912 per year, chemical and ceramic engineers ranked second with 10 percent earning more than $9,103, and were followed in order by mechanical and industrial engineers ($8,508), electrical engineers ($7,185), and civil engineers ($6,507). At the upper 25-percent level, mining and metallurgical engineers reported earnings of $6,301 per year, and those of the other professional classes ranged from 4 percent lower for chemical and ceramic engineers to 28 percent lower for civil engineers. This order of professional classes was also maintained in 1932 and 1934.

Between 1929 and 1934 the median earnings of all engineers from all sources declined from $3,412 to $2,286, or 33.0 percent. The percentage decrease of the earnings of the highest 10 and 25 percent were about the same as that noted for the median. On the other hand, in 1934, 10 percent of the engineers earned less than $872, a decrease of 53.6 percent at this income level. Almost two-thirds of these decreases in earned annual income occurred between 1929 and 1932. There were further decreases from 1932 to 1934.

Over the period 1929 to 1934, relatively, the smallest shrinkages in earnings were reported by the civil engineers, while the chemical and ceramic engineers suffered the greatest cuts. The median income of the former group declined 30.2 percent; of the latter group, 46.2 percent. The decrease for electrical engineers was 32.3 percent; for mining and metallurgical engineers it was 34.5 percent; and for mechanical and industrial engineers, 37.2 percent.

Annual income related to age, all engineers combined.—Analysis of the income data reported by all engineers in 1929, 1932, and 1934 shows that average earnings advanced with age up to 60 or 65 years of age. The initial periods of exceptionally rapid rise are followed by slower rates of increase. Thus in 1929 the median earnings of those graduating in 1927–28 were $2,098 and were $3,145 among those who graduated in 1921–24. The average of those who graduated in 1889–96 ($4,968) was little higher than the average of the group graduating in 1897–1904. Similar relationships, but with lower average earnings for each age group, prevailed in 1932 and 1934.

The earnings of the upper 10 percent in each age group advance more rapidly than median earnings. Thus, in 1929, the highest 10 percent of the engineers 25 years of age earned 45 percent more than the median engineer of that age. At 44 years the earnings of the upper 10 percent were 116 percent greater than the median, and at 60 were 157 percent greater. On the other hand, the level of earnings of the lowest 10 percent of the engineers of a given age advances less rapidly than at the median level and reaches a maximum at an earlier age. In 1929, 10 percent of the 25-year-old engineers earned less than $1,462, while 10 percent of those who were 44 earned less than $2,683.

Even in 1929, in every age group there were some 10 percent or more of the engineers who earned less than an average engineer who had been out of college 4 years or more. With advancing age, therefore, the spread between the earnings of the most successful and the least successful engineers became greater. This tendency was more pronounced in 1934 than in 1929. Thus, in 1929 the upper 10 percent of those graduating in 1889–96 earned more than 5.5 times as much as the lowest 10 percent. In 1934, when many were unemployed, the upper group averaged 10.7 times as much as the lower.

Comparison of the earnings of engineers of identical ages in 1929 and 1934 shows that the average income of engineers who had been out of college for 2 years declined 43 percent. The income of those who had been out 5 years declined 35 percent. For older engineers the decline approximated 30 percent.

In all but the youngest age groups the earnings of identical graduating classes were lower in 1934 than in 1929. Among the very youngest identical group for whom figures can be shown, the classes of 1927–28, the tendency for earnings to advance with experience almost exactly offset the tendency of earnings for any given job to decline during the depression.

Annual income and education.—Consideration of the incomes reported by engineers of different educational backgrounds shows that those with a formal engineering education did receive a higher income. The differences in earnings, however, did not accrue in equal measure for all five professional classes.

At the lowest ages, engineers who have achieved professional status after a high-school education enjoy an advantage in earning capacity. At about 28 years of age this initial advantage is lost. The 1929 average earnings of the graduates in various classes of engineering ranged from $2,725 to $3,000 per year, and those of the corresponding "other" or nongraduate group of engineers from $2,430 to $2,650.

With advancing age, the spreads in earnings in favor of the graduates became very marked indeed. For example, at 5, 20, and 37 years after graduation, the earnings of first-degree mechanical and

industrial engineers exceeded by $175, $925, and $1,322 per year those of the engineers of the same professional class whose college course was incomplete, and surpassed by $225, $1,160, and $1,815 per year those of engineers with a noncollegiate technical-school education.

Even in the graduate groups there was variation in the increases in earning capacity with age among the several professional classes. Thus, the 1929 earnings of first-degree civil engineers who had been out of college for 5 years were only $2,050 less than the earnings of those who had graduated 30 years before, whereas the corresponding difference for chemical and ceramic engineers was $3,600. The ranges in earnings of the remaining graduate groups fell between those reported by the civil and the chemical and ceramic engineers.

Sources of Earned Annual Income, 1929 to 1934

Annual incomes from engineering and nonengineering work.—In 1929 there was greater spread in the earnings of engineers engaged in nonengineering work than in those obtained from engineering work. Thus, among engineers 40 to 47 years of age, 10 percent of those engaged in nonengineering earned more than $12,424 and 10 percent earned less than $2,420 per year. The respective annual incomes of similar proportions of all those engaged in engineering work were $9,815 and $2,705; and of graduates in engineering $10,088 and $2,936.

The age of maximum earning power for engineers arrives more quickly for nonengineering than for engineering work. Thus, at 48 to 55 years of age, those college graduates who stayed in engineering were doing as well as those who had gone into nonengineering work. This was true even at the highest income levels. But despite the fact that in 1929 the tendency was for average annual incomes of engineers engaged in nonengineering to exceed slightly those in engineering work, the opportunities in nonengineering fields did not embrace more than 7 percent of the total number of engineers in any one age classification.

Over the period 1929–34 the relationship changed between the jobs engineers took in engineering and nonengineering work. On the whole it appears that in 1929 nonengineering work was an alternative to engineering work, but from 1929 to 1934 many nonengineering jobs were accepted as an alternative to unemployment or work relief.

Those engineers who were able to stay in engineering fared better than those engaged in nonengineering work. Thus, the group of engineers who were engaged in engineering in 1929 when they were 44 years of age averaged $4,562, while the smaller group in engineering in 1934 averaged $3,524.

It was among those newcomers who were trying to force their way into the profession that the greatest fall in annual income from engineering occurred. Thus, average earnings in engineering in 1934, 2 years after graduation, were 37 percent less than in 1929. The earnings of those who had been out of college 10 years were 31 percent lower in 1934 than in 1929. At higher ages all groups averaged a decrease of 26 percent.

Annual incomes of unemployed engineers.—In 1934 almost one-tenth of the engineers were unemployed or on work relief at the end of the year. The low level of earnings of this group during 1934 contributed to lowering the average earnings of all engineers. Thus, of those engineers who were unemployed at the end of 1934 the average earnings for the preceding 12 months of those who were less than 28 years of age ranged from $700 to $950. Engineers of 40 to 50 years averaged $1,350. Only about 10 percent of the unemployed, even though they were in those ages at which engineering earnings reached a peak, had made as much as $2,000 in the preceding 12 months. Ten percent made less than $300 a year.

Monthly Earnings of Professional Engineers, 1929 to 1934

Although the general changes in monthly rates show similar tendencies to those already described concerning annual earnings data, it should be emphasized that monthly engineering earnings give a more accurate measure of the rate at which engineering services are compensated than do the annual earnings from engineering work because the latter figure is influenced by continuity of employment as well as rate of remuneration.

One of the most important additions to the earlier data is a clarification of the relationship of engineering entrance rates and rates in succeeding years. Annual data for a class graduating in the middle of the year under consideration are of little significance; monthly rates are significant. Therefore, and directly supplementing what has already been said, it may be noted that 1929 average engineering earnings for the graduating class of 1929 were $149. The average in 1929 for the class of 1927–28 was $181. The 1934 average entrance rate was $110. The range of rates of earnings embracing four-fifths of the engineers of the class of 1929 in 1929 was $115 to $215. The corresponding range in 1934 was $75 to $149. The upper level of 1934 was the same as the average of 1929.

Thus, from this more exact measure of entrance rates, it is possible to see the extent to which the depression and the pressure for jobs slowed down the rate of increase in earnings from engineering. Thus the average monthly rate received by 1929 graduates in 1929 was $149. In 1932 it was $156 for such of this class as were engaged in engineering and in 1934 was $162. Those of the class of 1932 in

engineering averaged $111 in 1932, as against $124 in 1934. It became progressively more difficult to gain valuable experience. In 1929 the group with 1 or 2 years experience averaged $181, while the entrance group averaged $149. In 1932 the corresponding averages were about $135 and $111. In 1934 they were about $120 and $110.

Engineering Earnings Without Regard to Kind of Engineering Employment in 1929, 1932, and 1934

Earnings of all engineers combined, without regard to age.—In 1929, the range in monthly engineering earnings of professional engineers was very great. Some 79 engineers reported earnings of less than $60 per month, while 168 earned more than $1,880 a month. The median monthly earnings of the 28,511 reporters engaged in engineering was $289. One-quarter earned more than $415, while only 10 percent had earnings greater than $609 a month. Between 1929 and 1934 there were progressive declines in monthly engineering earnings. While the sharpest absolute decreases occurred at the higher levels of earnings, the greatest percentage decreases took place at the lower earnings levels. Almost two-thirds of the decreases occurred between 1929 and 1932.

Monthly earnings by professional class, without regard to age.—Comparison of earnings by professional class, without regard to age and the consequent effect of the varying age distributions, shows that in 1929 the upper 10 percent of mining and metallurgical engineers (highest at this level) reported earnings of not less than $792 per month as against $515 a month for civil engineers, who were lowest at this level. Next to mining and metallurgical engineers came chemical and ceramic engineers, followed by mechanical and industrial, and electrical engineers. For the upper 25 percent of the reporting engineers the order of the professional classes was the same, monthly engineering earnings ranging from not less than $372 for civil engineers to not less than $503 a month for mining and metallurgical engineers. At the middle and lower earnings levels, the differences in earning capacities of the 5 professional classes were less marked, although, in each instance, mining and metallurgical engineers and electrical engineers occupied the upper and lower extremes, respectively.

In 1932 and 1934 the order of the professional classes at the two higher earnings levels was essentially the same as that noted for 1929. At the three lower earnings levels shifts occurred in this order in 1929 and there were further shifts in 1932 and 1934.

Earnings related to age, all engineers combined.—On an age basis the 1929 monthly compensation for engineering services of the lowest tenth of reporting engineers was more than twice as high for those in the age group 48 to 55 as for those of 23 years. At the upper 10-percent earnings level, maximum earnings of $1,050 a month were

reached in the sixties. Similarly, at the average and at the upper and lower quarters earnings levels, age 60 was the turning point.

For men of identical ages in 1929, 1932, and 1934 the data reveal that the greatest impact of the depression, as far as engineering earnings were concerned, fell upon men with from 2 to 5 years' experience.

Earnings and education.—Although the 1929 data on engineering earnings reveal an advantage in favor of men who have engineering degrees, this advantage was less clearly defined than was the case with earned annual incomes. However, the extra years of experience which the "other" or nongraduate engineers had while the graduates were in school permitted of their obtaining higher earnings than graduates only up to a point corresponding to 5 years after graduation. Even at 2 years after graduation the differentials in earnings between the two groups were slight. Similarly, at 4 years after graduation, while at the median level graduate earnings ranged from $225 for first-degree electrical engineers to $250 a month for first-degree chemical and ceramic engineers, among the "other" or nongraduate engineers they ranged from $200 for engineers with secondary-school education to $229 a month for mechanical and industrial engineers with incomplete college courses.

With advancing age there was a considerable advantage in engineering earnings in favor of the graduates. This was an average advantage, however, for there was a distinct variation in the earning capacities among both graduates and "other" or nongraduate engineers. The monthly engineering earnings of graduates continued to increase several years beyond the point of maximum earnings of "other" or nongraduate engineers. The earnings of the latter either remained stable or declined after 53 years of age.

Earnings by kind of engineering employment.—With due allowance for varying proportions of experienced engineers in the several professional classes, it appears that in 1929, and among those engineers in the employ of private firms, mining and metallurgical engineering paid the highest rates for engineering services, followed by chemical and ceramic engineering, mechanical and industrial engineering, civil engineering, and electrical engineering. In the order as stated, the median monthly engineering earnings reported for 1929 were $338, $341, $314, $300, and $276. These relationships held at all levels of earnings with only one significant exception. From 1929 to 1934 there were large decreases in the rates of pay at all earnings levels among engineers in the employ of private firms.

In both 1929 and 1934, there was a marked spread in the earnings in private firm employment of each professional group. Thus, while the earnings of the upper 10 percent of reporting civil engineers were 106 percent greater than the median earnings of the group, the

corresponding difference for mining and metallurgical engineers was 135 percent. For the other three professional classes, the differences were: 111 percent for electrical engineers, 117 percent for mechanical and industrial engineers, and 119 percent for chemical and ceramic engineers.

In 1929 there was a considerable range in earnings opportunities among the various kinds of engineering employment. Thus, while one-half of the engineers in the employ of State and county governments earned not less than $236 a month, the lowest at this earnings level, the highest median monthly earnings of $439 were reported by independent consultants. Intermediate between these median monthly earnings lay teaching ($310), private-firm employment ($301), municipal government and other public authorities ($272), and Federal Government ($264).

The gradation of earnings in 1929 at the two lower earnings levels was the same as that noted for the median. But at the two higher earnings levels private-firm employment exceeded teaching, being second in order after independent consultants, while the earnings of all three public engineering employments were lower in each instance than those of engineers engaged in teaching.

Over the period 1929–34 there was an especially marked decline in the earnings of independent consultants as compared with the decline in rates for the other kinds of employment. These changes are to be regarded as in large part a measure of underemployment.

In the other kinds of employment, the largest decline (27 percent) in average rates paid was in private-firm employment. The smallest decline (14 percent) was in teaching. Average compensation by the Federal Government for engineering services declined 23 percent, as against 19 and 17 percent, respectively, for State and county governments, and municipal and other public authorities.

In private firm employment, in teaching and among engineers employed by municipal and other public authorities, earnings of the upper 10 and 25 percent declined less than the average; earnings of the lower 10 and 25 percent, somewhat more than the average. In Federal Government employment, the declines at all but the highest level of earnings were similar to the decline of the average rate.

Separate analysis of the earnings data for older engineers and younger engineers emphasizes the extent to which earnings in 1934 were diluted by the influx of younger engineers. Thus, while consideration of each group of engineers as a whole revealed a greater decline in earnings at the lower levels than at the higher, for the older engineers the four other earnings levels sank in almost exactly the same ratio as the average in the case of private-firm employment, teaching, Federal Government, and State government employment.

Earnings by field of engineering activity.—In general it may be said that at all earnings levels, and among engineers with 5 years or more of experience, State and county employment is at lower rates than Federal or municipal. For civil engineers, electrical engineers, and mechanical engineers public employment averaged less than any of the fields of private employment, except construction.

For example, while civil engineers averaged $234 per month in municipal employment and $232 per month in the private construction industry, in the other fields of private employment the range in monthly earnings was from $248 to $270. By contrast, chemical and ceramic engineers with the Federal Government averaged $300 per month in 1934 as against $296 in private manufacturing industries.

Within the various fields of private employment, average rates in the construction industry are low. Furthermore, in the five fields of private engineering activity and in personal service, chemical and ceramic engineers and mining and metallurgical engineers appear to have a distinct advantage in earnings, whereas among the three other professional classes the differences in the median monthly earnings reported were not very great.

There was less spread in the earnings reported for public employment than those received by engineers in the other fields of engineering activity. For example, while the median earnings of civil engineers in Federal employment were $221 a month, at the upper 10-percent earnings level the earnings received were $375 a month. By contrast, civil engineers in manufacturing received median monthly earnings of $248 a month and $488 a month at the upper 10-percent level.

Among engineers born in the years 1907–9 and 1910–14, the monthly earnings received for public construction work were slightly greater than those received for private construction work. And except for private construction, there was very little difference in the earnings reported by the two groups of younger engineers engaged in public construction and those received in the other fields of engineering activity.

Earnings by type of engineering work.—For engineers with 5 years of experience or more, those engaged in general administration and management were without any important exception the best-paid group. On the average, engineers engaged in general administration make from half again to twice as much as those engaged in design, construction, or operation. For example, mechanical engineers engaged in design and research averaged $228 while those in general administration and management averaged $324 per month.

Consulting, teaching, and sales in all instances average less than administration and generally average more than design, construction, and operation.

In all professional classes, except electrical engineering, higher rates were paid in design and research and in operation than in construction. For example, while civil engineers engaged in construction reported median monthly earnings of $211, members of this same professional class engaged in design and research and operation received, respectively, $218 and $226 a month.

Mining engineers averaged nearly the same in design and research as in operation. But in the case of both chemical and ceramic engineers and electrical engineers, those engaged in design and research averaged more than those engaged in operation, and at the higher levels of earnings the differences between them were even more marked.

Within each type of work, construction excepted, chemical and ceramic engineers, and mining and metallurgical engineers had the advantage. For example, the former professional class reported median monthly earnings of $285 for design and research; the latter received $262 a month. The range in monthly earnings for the three other professional classes was from $218 to $228.

Due to the variations in spread, these differences in earnings became accentuated at the two higher earnings levels. For example, while mining and metallurgical engineers reported median monthly earnings of $393 for general administration and management, one-quarter received not less than $618 a month and one-tenth not less than $1,028 a month. The corresponding figures for civil engineers engaged in the same type of work were $312, $426, and $587 a month.

Although the spread in earnings for consulting was less than that noted for general administration and management, it was relatively greater than that which occurred in any of the other types of work. The smallest spread occurred in the earnings reported for construction.

The earnings reported by the two groups of younger engineers show that in all types of engineering work younger engineers start with practically the same level of earnings.

Monthly earnings by geographical division.—In 1929, there were persistent differences in the average rates of pay of three types of engineering. Thus, graduate mechanical engineers in 1929 averaged higher than electrical or civil engineers in all geographical divisions, except the District of Columbia. In all regions, except New England, graduate electrical engineers earned less than graduate civil engineers.

Within the regions the spreads in earnings differ substantially. The differences in rates as between the various regions are not consistent from one group to the next, nor from one year to another.

The earnings of engineers in the Middle Atlantic States and the District of Columbia appear in general to be slightly above those in New England and the East North Central States. This is especially the case among civil engineers. These four regions are generally above

the Pacific States and the West South Central States, both of which rank fairly high as regards earnings of civil engineers.

Electrical engineers are as high in the Pacific States as in the East North Central. In 1934, especially, mechanical engineers in the West South Central States ranked as high as electrical engineers as regards average earnings.

In general, the lowest average rates were reported from the Mountain States and the West North Central, though the differences between the averages in these regions and the South Atlantic and East South Central States are not consistent.

Monthly earnings by size of city.—In 1929, there was an extreme range in average earnings among the cities with a population of 400,000 or more from about $280 per month for Los Angeles and Minneapolis and St. Paul to $351 in Pittsburgh. None of the 18 cities of 400,000 or more in 1934, and only two in 1929, had average earnings materially lower than the average in the smaller cities.

By and large, the cities of 400,000 or over appear to pay $200 to $250 more per year in average earnings than cities of 50,000 to 400,000. These in turn average $100 more than cities of 10,000 to 50,000; and these, perhaps $200 more per year than was paid in communities of less than 10,000. A situation similar to that noted for average earnings reported also occurred at the two lower earnings levels.

The concentration of opportunities for higher earnings in the larger cities is fairly well defined at the upper 25-percent level and more so at the upper 10-percent earnings level.

In only three of the cities with 400,000 population or more did the upper 10 percent of the engineers earn less than was earned at this level ($602) in cities of 100,000 to 400,000. In cities with less than 10,000 population, the upper 10 percent earned $503 or more in 1929. Similar differences obtained in 1934.

Among the younger engineers, there was almost no variation in their earnings by size of city.

Over the period 1929–34, the earnings at all income levels and for all cities declined. The smallest declines in average earnings were reported for the cities of San Francisco (15 percent) and Washington, D. C. (14 percent). But for the remaining cities the decreases ranged from 20 percent in the case of Los Angeles to as high as 31 percent for the city of Cincinnati.

Chapter I

Scope and Method

Prior to 1929 recessions in business activity in the United States were known to affect business profits and wage-earner employment. The professional worker was not immune to loss of employment and earnings, but his problems were apparently entirely different from those of the wage earner. The inconveniences of professional workers arising from reductions in salaries or unemployment appear to have been of short duration. These conditions, however, did not obtain in the depression years 1930 to 1934, inclusive.

Early in 1930 unemployment became a national problem and struck simultaneously nonprofessional and professional workers. As the depression lengthened in time and increased in intensity, its effects upon professional engineers became evident. But professional workers concerned with this problem were confronted with the lack of reliable data that could have been used as a basis on which to formulate plans to bring about an amelioration in the situation. Consequently, at the request of American Engineering Council, toward the end of 1934, the Bureau of Labor Statistics undertook a survey of the engineering profession in cooperation with a committee representative of all branches of professional engineering activity.[1]

Purpose and Collection of Data

The primary purpose of this survey was to determine the extent of unemployment among professional engineers in the period 1930–34. It was also desired to determine what kind of professional employment gave engineers the greatest protection against unemployment, where they found substitute employment, and their earnings between January 1, 1929, and December 31, 1934.

The data were obtained through the medium of a mail questionnaire [2] requesting information from professional engineers for the three periods ending December 31, 1929, 1932, and 1934. The questions covered present residence; age; marital status and number of dependents;[3] educational background; employment status; unemployment and relief; earned annual income; rates of monthly compensation from engineering work; membership in engineering societies;[3]

[1] The Bureau's studies have dealt almost entirely with wage-earning groups. The only other professional group recently studied were editorial employees of newspapers. For data on the results of that survey, see Monthly Labor Review, May 1935, p. 1137 (also printed as B. L. S. Serial No. R. 239.).

[2] See appendix A, p. 214, for facsimile of questionnaire used in the survey.

[3] No analysis was made of this information.

method of obtaining employment, together with information on contract and pension privileges; patent rights; civil-service status; field of engineering activity and type of work within that field; and professional class. A copy of this questionnaire was sent to each of 173,151 professional engineers.

The mailing list for the questionnaire was compiled for the Bureau through the cooperation of National, State, and local engineering societies. They also secured additional names from 32 State boards of engineering examiners, and the deans of 156 engineering schools for graduates in the classes of 1930–34. At the time the request for names was issued there were known to be in existence 80 National, 42 State, and 197 local engineering societies, and of these, respectively, 73, 39, and 121 submitted names from their past and present membership rosters. The cooperating bodies embraced every phase of professional engineering activity. The original mailing list, from which duplications were eliminated, is the most inclusive that could be devised for the profession. As regards engineers who entered the profession in 1929 or earlier, it is representative, except as membership in an engineering society may introduce a selective bias. This bias was minimized by drawing upon the roster of past membership so that the selective effect of unemployment during the depression does not affect the list. As regards those who prepared to enter the profession since 1929, it is virtually all-inclusive of graduates from engineering colleges and universities. There may be some under-representation of engineers drawn from the ranks or from noncollegiate technical schools in recent years. While this possibility exists, the evidence leads to the belief that it is not an important source of error.

The Number of Returns

Of the 173,151 questionnaires sent out 58,388, or 33.7 percent, were returned with information; 5,883, or 3.4 percent, were returned as "not found." The net number of usable returns was 52,589, or 30.4 percent of the number of persons on the original mailing list. No follow-up method was used. The extensive response was due largely to the publicity given to the survey by the cooperating bodies through their official publications and attests the interest that professional engineers felt in the problems of their profession.

The returns covered every State and the District of Columbia, and ranged in number from 101 in Nevada to 7,659 in New York. (Table 1.) In view of the small number of returns from individual States—in only 13 cases were more than 1,000 reports received from a single State, while in 24 States less than 500 were received—the States were grouped according to the census geographical divisions, with the single exception that the District of Columbia was segregated from the

South Atlantic region and presented separately. This segregation was deemed advisable in that the majority of engineers reporting from the District of Columbia were in the employ of the Federal Government. On this regional basis, the returns from all engineers in the nine professional classes combined ranged from 948 in the District of Columbia to 14,977 in the Middle Atlantic region.

TABLE 1.—*Distribution at end of 1934 of professional engineers reporting, by geographical division and State*

Geographical division and State	Number reporting	Geographical division and State	Number reporting
United States	52,589	New England	4,674
		Connecticut	934
District of Columbia	948	Maine	322
East South Central	1,544	Massachusetts	2,717
Alabama	343	New Hampshire	227
Kentucky	402	Rhode Island	313
Mississippi	268	Vermont	161
Tennessee	531	West North Central	4,978
Mountain	2,434	Iowa	902
Arizona	369	Kansas	740
Colorado	908	Minnesota	1,265
Idaho	197	Missouri	1,224
Montana	291	Nebraska	398
Nevada	101	North Dakota	172
New Mexico	156	South Dakota	277
Utah	254	Pacific	5,651
Wyoming	158	California	4,389
West South Central	2,486	Oregon	427
Arkansas	171	Washington	835
Louisiana	481	East North Central	10,977
Oklahoma	509	Illinois	3,689
Texas	1,325	Indiana	1,316
South Atlantic	3,920	Michigan	1,951
Delaware	195	Ohio	2,999
Florida	626	Wisconsin	1,022
Georgia	592	Middle Atlantic	14,977
Maryland	628	New Jersey	3,323
North Carolina	421	New York	7,659
South Carolina	295	Pennsylvania	3,995
Virginia	678		
West Virginia	485		

TABLE 2.—*Geographical distribution at end of 1934 of the 9 major professional classes of engineers*

Professional class [1]	Geographical division										
	Total	District of Columbia	East South Central	Mountain	West South Central	South Atlantic	New England	West North Central	Pacific	East North Central	Middle Atlantic
All classes	52,589	948	1,544	2,434	2,486	3,920	4,674	4,978	5,651	10,977	14,977
Agricultural	397	9	21	20	36	38	10	123	38	71	31
Architectural	538	10	8	20	22	29	44	107	30	139	129
Ceramic	388	3	11	2	5	22	10	38	26	169	102
Chemical	3,512	37	107	108	213	291	369	296	179	878	1,034
Civil	19,891	450	707	1,191	1,082	1,619	1,631	2,295	3,099	3,294	4,523
Electrical	11,443	195	286	385	489	856	1,080	991	920	2,412	3,829
Industrial	1,007	6	19	14	18	76	129	56	44	270	375
Mechanical	13,226	197	320	285	548	898	1,313	884	986	3,343	4,452
Mining and metallurgical	2,187	41	65	409	73	91	88	188	329	401	502

[1] From the Office of Education returns it was found that, while the number of professional classes was large (primarily due to specialization), nearly 90 percent of all engineering graduates in any one year were confined to the 9 professional classes of agricultural, architectural, ceramic, chemical, civil, electrical, industrial, mechanical, and mining and metallurgical engineering.

The number of engineers reporting other professional classes were so small that special analyses were not warranted. These were combined with one or other of the major professional classes to which they were most closely allied. These particular data are presented in appendix B, p. 218 table 1.

On a national basis the range in the returns of each of the 9 professional classes was from 388 for ceramic engineers to 19,891 for civil engineers (Table 2). It was not feasible consistently to analyze separately the smaller groups: Agricultural, architectural, ceramic, and industrial engineers. The first two are therefore at times merged with civil engineers, the third with chemical, and the last with mechanical engineers.

Comparison With Previous Studies

The gross number of returns, namely, 52,589, makes this survey unique in size and comprehensiveness. With regard to size, three previous major studies can be cited: (1) The one made in 1924 by the Society for the Promotion of Engineering Education [4] of engineering graduates and nongraduating former students, which dealt with data collected from 7,000 individuals; (2) the American Society of Mechanical Engineers' study [5] of 1930, which was based on returns from approximately 8,000 engineers; and (3) the American Society of Civil Engineers' study [6] of 1934, which included 16,000 engineers. The present study is the first one in which it has been possible to collect sufficient detail to compare the status of engineers in the several branches of professional engineering activity under approximately the same conditions on a Nation-wide basis.

The Components of the Sample

Although the returns covered members of nine major professional classes of engineers, cognizance must also be taken of two other factors which vitally affect the whole of the ensuing analysis: (1) Differences in educational background, and (2) differences in the length of time that the reporting engineers had been in the profession. Classifications by education and by age or years since graduation have been followed for each professional class.

In regard to differences in educational background, the reporting engineers have been grouped in three classes to cover graduate engineers, while three others embrace those engineers who did not report graduation after four years' attendance at a recognized university or college. More specifically, the three types of graduate education are: (1) Postgraduate, (2) nonengineering graduates,[7] and (3) first-degree

[4] Bulletin No. 3, Report of the Investigation of Engineering Education, Engineering Education, vol. I, Society for the Promotion of Engineering Education, University of Pittsburgh, Pittsburgh, Pa. Lancaster Press, Inc., Lancaster, Pa., 1930.

[5] 1930 Earnings of Mechanical Engineers, Mechanical Engineering, September and November 1930 and December 1931. American Society of Mechanical Engineers, New York, N. Y.

[6] Revised Report on Salaries of Civil Engineers, Civil Engineering, vol. 4, No. 8, pp. 423–425. August 1934. American Society of Civil Engineers, New York, N. Y.

[7] Primarily, graduates with liberal arts degrees and a major in some field closely allied to engineering, such as mathematics, physics, or chemistry, and who reported they were actually engaged in engineering work for one of the three periods.

engineering graduates. The engineers classified in the three other types of education have been collectively designated as "other" [8] engineers and cover men who reported (1) an incomplete college engineering course, (2) noncollegiate technical school education, and (3) secondary-school education only.[9]

Within each type of education, the differences in experience spans comprise two broad groupings of the reporting engineers. First, those who reported for the year 1929 and were, therefore, professionally active prior to 1930; and, second, those engineers who had entered the profession in one of the years 1930–1934, inclusive, and who could not have reported for the year 1929. For purposes of this survey, the former group are referred to throughout the discussion as "older" engineers, while the latter are designated as "younger" engineers. The gross returns received from the 52,589 professional engineers comprise 33,841 who reported they were professionally active prior to 1930, and 18,748 who entered the profession in the period 1930–34.

At this point it is pertinent to note that, in the absence of a satisfactory definition of the term "professional engineer," this report is being based primarily on one criterion of professional engineering status, namely membership in an engineering society. In the case of the older engineers, this criterion may be applied without qualification. But even as regards the younger engineers, it also has considerable merit. Their names, it will be recalled, were furnished by the deans of practically every engineering school in the country. But inquiry revealed that a substantial number of these names were also furnished by engineering societies. This is explained by the fact that even in the sophomore year many engineering students obtain student memberships in one or another of the engineering societies. In the junior and senior years there is a marked increase in the number of such candidates.

Adequacy of Returns Received from Engineers Entering the Profession Prior to 1930

To check the returns received from those engineers who reported they were professionally active prior to 1930, comparisons of these figures were made with those on technical engineers as contained in the Fifteenth Census, volumes IV and V, Population, U. S., 1930 census.

[8] In the text, the term "other" engineers is used interchangeably with nongraduate engineers. Whenever possible, the former is preferred because engineers who attended noncollegiate technical schools received diplomas after as many as 3 years of study. Strictly speaking, therefore, they are graduates.

[9] Throughout this report, age and years after graduation are used interchangeably. Of course, in the case of nongraduates (i. e., "other" engineers) age only applies. The relationship between these two factors can readily be derived from the fact that the median age of graduation of new entrants to the profession was found to be 23 years.

The appropriateness of the census data as a basis for comparison will be seen to be warranted in the discussion which deals with the growth of the profession. At this time, it needs merely to be noted that these data do not permit of making separate analyses for the reporting graduates and "other," or nongraduate engineers.

In order to insure that the returns from the older engineers adequately represented the engineering profession throughout the whole country, consideration was first given to the reports received from each of the 10 geographical divisions. For purposes of comparison with the 1930 census data, it was necessary to make certain groupings of the nine professional classes tabulated. These groupings comprise (1) chemical, mining, and metallurgical engineers, (2) civil engineers and surveyors and architectural engineers, (3) electrical engineers, and (4) mechanical, agricultural, ceramic, and industrial engineers and all other engineers not elsewhere classified.

The numbers of engineers so reporting in the survey without regard to age and the corresponding figures on technical engineers in the 1930 census are presented in table 3.

Returns from the separate groupings of professional classes do show a considerable variation. Of the chemical engineers group active prior to 1930, apparently 24.7 percent reported in 1935. Reports from mechanical engineers and all others embraced 17.7 percent; of the civil engineers, 14.4 percent; and of the electrical engineers, 11.5 percent reported. Similar differences between the professional classes were found in the separate regions, though, as was to be expected when the national sample was broken down, differences in the proportions of returns became more accentuated when considered on a regional basis. It should also be noted that in every district except the Pacific and Mountain States a larger proportion of chemical and mining and metallurgical engineers reported than in any other class. Second in order of frequency of reporting were mechanical and other engineers in every district. Civil engineers were third, except in the South Atlantic and the Pacific States.

The causes of these variations cannot be determined. Their effect, however, should be noted. For example, in connection with an analysis of earnings for all engineers without regard to professional class, the presence of a relatively large proportion of chemical engineers will raise the average somewhat above its true level. No attempt has been made to apply weighting factors for these differences in returns, because the differences in the end products are not great enough to necessitate it. But for this reason the analyses for the separate professional classes are probably more accurate than the analysis of all engineering. As regards the analysis of the separate professional classes, it may be noted that at least one-ninth of all engineers was included even in the class with the smallest coverage, a large enough

TABLE 3.—*Numbers of older*[1] *professional engineers reporting in sample and in 1930 census,*[2] *by geographical division*

Geographical division	Gross numbers reporting										Percentage number reporting in sample formed of 1930 census figures				
	All professional classes		Chemical, mining, and metallurgical		Civil engineers and surveyors		Electrical		Mechanical and all others[3]		All professional classes	Chemical, mining, and metallurgical	Civil engineers and surveyors	Electrical	Mechanical and all others
	Sample	Census	Sample	Census	Sample	Census	Sample	Census	Sample	Census					
Total for United States	33,841	226,136	2,961	11,966	14,651	102,057	6,623	57,775	9,606	54,338	15.0	24.7	14.4	11.5	17.7
District of Columbia	713	1,892	60	87	373	1,058	123	373	157	374	37.7	69.0	35.3	33.0	42.0
East South Central	889	7,362	91	330	430	4,509	151	1,535	217	988	12.1	27.6	9.5	9.8	22.0
Mountain	1,590	7,355	337	1,591	878	3,553	189	1,342	186	869	21.6	21.2	24.7	14.1	21.4
West South Central	1,369	13,078	125	587	681	8,212	216	2,505	347	1,774	10.5	21.3	8.3	8.6	19.6
South Atlantic	2,584	15,924	197	735	1,242	9,080	474	3,440	671	2,669	16.2	26.8	13.8	13.8	25.1
New England	2,693	16,370	175	474	1,105	6,922	559	4,156	854	4,818	16.5	36.9	16.0	13.5	17.7
West North Central	2,940	15,401	205	621	1,622	8,948	505	3,387	608	2,445	19.1	33.0	18.1	14.9	24.9
Pacific	4,343	27,138	340	2,367	2,628	14,231	594	5,589	781	4,951	16.0	14.4	18.5	10.6	15.8
East North Central	6,630	51,523	556	1,979	2,312	19,059	1,366	13,263	2,396	17,222	12.9	28.1	12.1	10.3	13.9
Middle Atlantic	10,090	70,093	875	3,195	3,380	26,485	2,446	22,185	3,389	18,228	14.4	27.4	12.8	11.0	18.6

[1] Includes those engineers who reported they were professionally active prior to 1930.
[2] Data on technical engineers in the Fifteenth Census, vols. IV and V, Population, United States, 1930 Census.
[3] Agricultural, ceramic, and industrial engineers and all other engineers not elsewhere classified.

coverage to warrant belief that it may be fully representative of the professional class.

As regards all professional classes combined there were returns from 15.0 percent of the engineers reported by the 1930 Census. These were well distributed regionally. Returns from four regions fell within the range of 14.4 percent and 16.5 percent. The lowest percentage of returns was 10.5 percent for the West South Central. The Mountain States averaged 21.6 percent. The District of Columbia, with 37.7 percent as many returns for older engineers in 1935 as in the census of 1930, is an obvious exception.

None of these regional differences warrant efforts at reweighting the sample covered by the survey. In point of fact, they are the best quantitative index available of the shifts in economic opportunity for engineers from 1930 to 1935. For example, the present study shows an increase of 88.1 percent in Federal Government employment from the end of 1929 to the end of 1934 among older engineers, thus confirming the evidence of table 3, which at first glance shows an apparently disproportionate large number of returns from the District of Columbia.

The method adopted to check the age composition of the returns from the older engineers was as follows: The number reporting in the sample was tabulated with regard to age in 1930 by intervals corresponding to those used in the census of 1930. The number in each age interval was calculated as a percentage of the grand total reporting age and compared with a series of similar computations derived from the 1930 census data. This was done for all engineers classified in the four groupings of professional class within each geographical division.

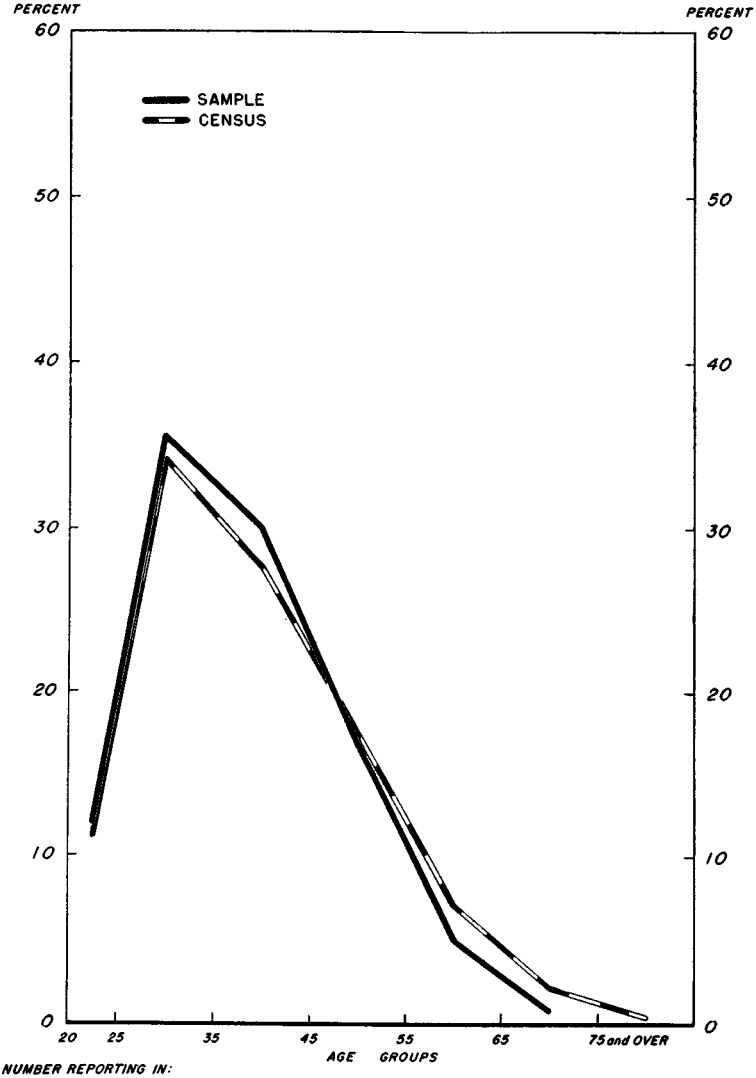
In this connection, it should be noted that age was reported by 33,494 of the 33,841 older engineers, that is, by all but 1.0 percent. In the census, of the 226,136 technical engineers, age was reported by all but 180. The data on age are, therefore, comprehensively enough reported in both cases to permit close analysis.

The sample of returns appears to be fully representative of each age group. Because of the particular incidence of death and retirement upon the older engineers, it follows as a matter of course that it was impossible in 1935 to secure returns as of 1930 representing each age group in 1930 in the true proportions which had existed in that year. In the reporting sample, 5.7 percent of the engineers were 55 or older in 1930, whereas at the time of the census 9.7 percent of all engineers enumerated were 55 or more. Similarly, in the age groups 45 to 54 years the sample shows 16.7 percent and the census 17.4. The widening gap of returns with advancing age is precisely what should be expected. Conversely, the sample taken in 1935 produced a larger percentage of engineers who were 20 to 44 years old in 1930

CHART I.

DISTRIBUTION CURVES OF ALL OLDER PROFESSIONAL ENGINEERS REPORTING AGE IN 1935 SURVEY AND IN 1930 CENSUS

ALL PROFESSIONAL CLASSES COMBINED



NUMBER REPORTING IN:

SAMPLE: 4,004	11,908	10,049	5,603	1,656	274	0	33,494
CENSUS: 25,273	77,216	62,360	39,265	16,136	4,880	806	226,956

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than did the census. The parallelism of the two curves in chart 1 and the reasonableness and consistency of the discrepancies leads to the conclusion that the whole sample is reasonably representative in 1934 of the age distribution of engineers who entered the profession before 1930. It is in the nature of retrospective surveys that the data for 1929 slightly underestimate the number of mature engineers in the profession at that time.

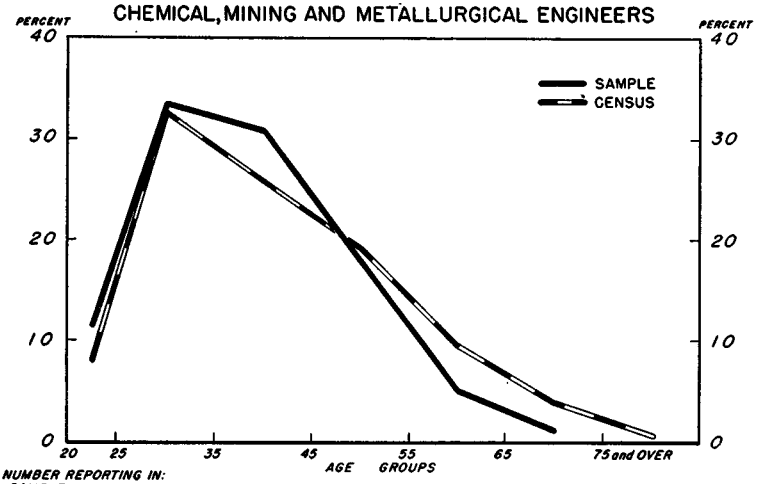
Approximate allowance for survival to 1935 may be made from census estimates of the number of males in 1935 by 5-year intervals. They may be compared with corresponding groups in 1930 to compute survival rates. These have been applied to engineers 25–34, 35–44, and 45–54 without developing any evidence of real differences in the ratios reporting. Above 55 years of age, to support the belief that the tendency to report was uniform at all ages, it is necessary to assume that one-quarter of the engineers 55–64 in 1930 had retired by 1935 when they would have been 60–69, and that about one-half of those 65 or more in 1930 had retired. It is further necessary to assume that those who retired did not, in general, respond to a questionnaire addressed primarily to employed or unemployed engineers. These assumptions are at least sufficiently reasonable so that it is unnecessary to reweight the relatively small number of reports involved for the purpose of calculating averages for the profession as a whole.

At worst, such underreporting as may possibly occur would only affect upper decile and quartile incomes. The order of such influence is indicated by the following comparison: Average annual income for older engineers only in 1934 was $2,670, without weighting the sample for different ages. If we increase the sample of those who were 50–64 in 1930 by one-third, and double the sample of those 65 or more, the average would be $2,699. However, the upper decile for the unweighted sample (i. e., the limit above which 10 percent of the earnings are found) is $5,679, and would be $5,827 if the sample were weighted as indicated. In the chapters which follow, each age group is separately analyzed.

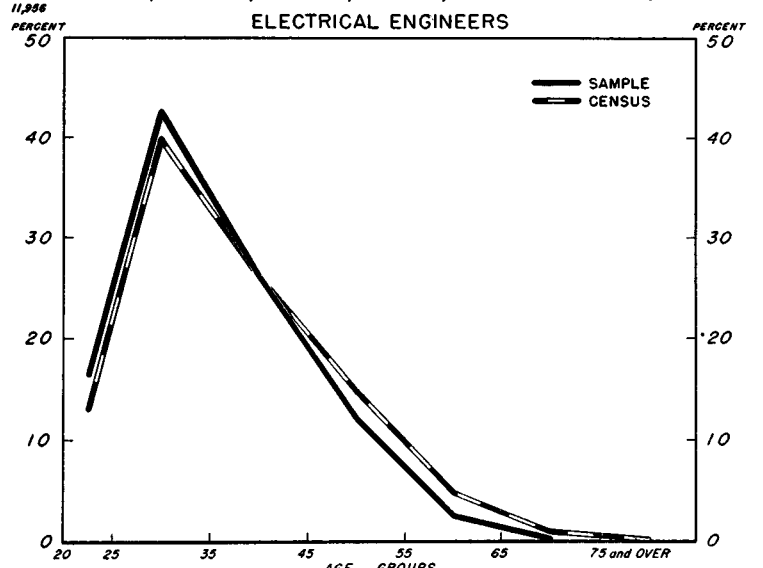
This conclusion as to the representativeness of the data as regards the age distribution of reporting engineers is further supported when the data are broken down by professional classes and by regions. Charts 2 and 2a present a comparison on a national basis of the age distributions in 1930 of the engineers reporting in 1934 and in the census for four groups of professional classes. Each distribution shows the general characteristics described above, with evidence of under-reporting by civil engineers and surveyors 20 to 34 and by chemical engineers above 35. The curves may be interpreted to indicate a relative over-representation in the sample in the case of mechanical engineers of those who were 25–34, and in the case of civil

CHART 2

DISTRIBUTION CURVES OF ALL OLDER PROFESSIONAL ENGINEERS REPORTING AGE IN 1935 SURVEY AND IN 1930 CENSUS BY PROFESSIONAL CLASS



NUMBER REPORTING IN:	20	25	35	45	55	65	75 and OVER
SAMPLE: 2,927	337	981	905	520	150	34	0
CENSUS: 11,956	957	3,923	3,098	2,297	1,143	466	72



NUMBER REPORTING IN:	20	25	35	45	55	65	75 and OVER
SAMPLE: 6,352	1,074	2,789	1,719	795	162	13	0
CENSUS: 57,730	7,559	22,992	15,140	8,568	2,639	589	43

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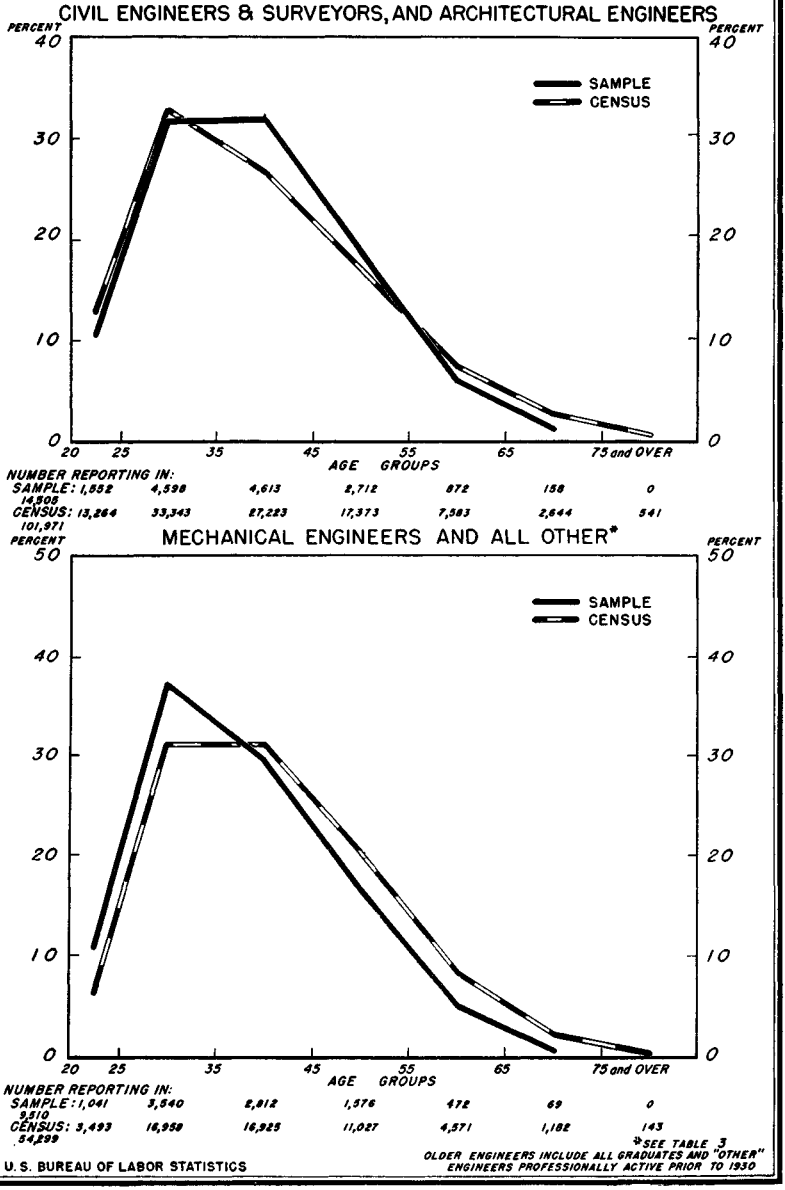
OLDER ENGINEERS INCLUDE ALL GRADUATES AND "OTHER" ENGINEERS PROFESSIONALLY ACTIVE PRIOR TO 1930

CHART 2a.

DISTRIBUTION CURVES OF ALL OLDER PROFESSIONAL ENGINEERS REPORTING AGE IN 1935 SURVEY AND IN 1930 CENSUS

BY PROFESSIONAL CLASS



engineers of those who were 35–44. In no case are the discrepancies serious.

On a regional basis, the comparison between 1930 and 1934, in view of the influence of migration, is hardly an important test of the representativeness of the sample, though the data appear fairly representative even on this basis. The data are themselves significant as indicating differences in the age distributions of engineers that have developed in the several regions since 1930.[10]

Adequacy of Returns Received from Younger Engineers

As in the case of the older engineers reporting, the 18,748 returns received from newcomers to the profession in the period 1930–34 were compiled on a professional class basis. Of this number, 195 were non-engineering graduates and 286 were classified as "other" or nongraduate engineers. There is no means of testing the relative adequacy of these samples. Because virtually all engineering school graduates received questionnaires, whereas "other" or nongraduate young engineers did so only if they were members of an engineering society, the latter type may not be represented in its true proportions.

The remaining 18,267 reports for graduates in engineering may be tested as regards representativeness against the total number of first-degree engineering graduations, as compiled by the Office of Education for 1930, 1932, and 1934 in their biennial surveys for the periods 1929–30, 1931–32, and 1933–34.[11] This comparison for 5 professional classes [12] is made in table 4 for each of the 3 years separately and against an estimate for the 5-year total. These data indicate the uniformity of the percentage of returns from this younger group of chemical, civil, electrical, and mechanical engineers. It ranges from an apparent coverage of 46.7 percent of the civil engineers in 1930 to a low of 33.3 percent coverage of electrical engineers in 1934. From year to year there is marked regularity of coverage for these four groups in combination. Returns from 1934 graduates are somewhat lower than from 1930 and 1932 graduates, but returns for 1931 and

[10] It may also be noted here that there is no means of testing the representativeness of the sample of older engineers as regards income. Membership in engineering societies may tend to have eliminated some of the lower incomes. There may have been somewhat less willingness to report high incomes than there was for average incomes. But without exception, the several distributions of income follow a consistent pattern even when analyzed in detail. Thus, the same type of distribution emerges when the data are analyzed by ages, by professional classes, or even on a regional basis. This is true of both annual income and monthly engineering income. We trust that the promise of confidence that accompanied the questionnaire removed unwillingness to report income more or less uniformly at all levels. At all events 88.7 percent of the older engineers reported income for 1929, without any great variation as between one age group and another. It remains for those with a critical and intimate knowledge of the profession to evaluate the adequacy of the returns of income.

[11] Totals for the 5 years have been computed by straight-line interpolation to estimate graduations in 1931 and 1933.

[12] In the case of the survey figures for civil, electrical, and mechanical engineers, there are included engineers with minor professional classifications. Spot checks of these data show that the majority so reporting were graduated prior to 1930. Hence, they do not unduly affect the comparisons for the younger engineers.

1932 graduates as compared with interpolated figures for graduations in these years show the same percentage coverage as 1930 and 1932.

TABLE 4.—*Numbers of 1930–34 engineering graduates reporting in survey and to the Office of Education*

Professional class	Total, 1930–34		1930		1931		1932		1933		1934	
	Sample	Office of Education[1]	Sample	Office of Education	Sample	Office of Education	Sample	Office of Education	Sample	Office of Education	Sample	Office of Education
	Number											
All classes	18,267	51,303	3,284	8,947	3,629	(2)	3,866	10,374	3,872	(2)	3,616	11,420
Chemical	1,948	5,562	319	818	327	(2)	413	1,148	423	(2)	466	1,359
Civil	4,618	10,220	924	1,977	990	(2)	925	2,100	951	(2)	828	2,036
Electrical	4,558	12,438	905	2,427	959	(2)	958	2,480	884	(2)	852	2,558
Mechanical	3,926	10,363	605	1,674	706	(2)	837	2,085	908	(2)	870	2,454
All others	3,217	12,720	531	2,051	647	(2)	733	2,561	706	(2)	600	3,013
	Percentage											
All classes	100.0	100.0	100.0	100.0	100.0	(2)	100.0	100.0	100.0	(2)	100.0	100.0
Chemical	10.7	10.8	9.7	9.1	9.0	(2)	10.7	11.1	10.9	(2)	12.9	11.9
Civil	25.2	19.9	28.1	22.1	27.3	(2)	23.9	20.2	24.6	(2)	22.9	17.8
Electrical	25.0	24.2	27.6	27.1	26.4	(2)	24.7	23.9	22.8	(2)	23.6	22.4
Mechanical	21.5	20.2	18.4	18.7	19.5	(2)	21.7	20.1	23.5	(2)	24.0	21.5
All others	17.6	24.9	16.2	23.0	17.8	(2)	19.0	24.7	18.2	(2)	16.6	26.4
	Percentage number reporting in sample formed of Office of Education figures											
All classes	35.6		36.7		(2)		37.3		(2)		31.7	
Chemical	35.0		39.0		(2)		36.0		(2)		34.3	
Civil	45.2		46.7		(2)		44.0		(2)		40.7	
Electrical	36.6		37.3		(2)		38.6		(2)		33.3	
Mechanical	37.9		36.1		(2)		40.1		(2)		35.5	
All others	25.3		25.9		(2)		28.6		(2)		19.9	

[1] The Office of Education total for 1930–34 includes estimated graduations in 1931 and 1933, which were computed by straight-line interpolation.
[2] Interpolated figures not shown.

The miscellaneous categories of the Office of Education were covered apparently only to the extent of 25.3 percent.[13]

In view of the uniformity of the percentage of returns in the main professional classes, it seems probable that this difference arises from differences in the methods of classification used by the Bureau of Labor Statistics and the Office of Education. The latter apparently followed more detailed distinctions within various types of education than did the Bureau. This cannot affect the later tabulations, however, because in no event were there enough returns from the highly specialized branches of engineering to permit their separate analysis in this study. All branches were recombined into the first four shown in table 4, with the addition of mining and metallurgical engineers.

[13] In the sample, this classification also includes 1,908 engineers who reported a professional class different from the field in which the degree was originally obtained. Due to the fact that all tabulations were controlled on the professional class reported, it was not feasible to make a separate analysis of these 1,908 reports.

Weighting Returns from Younger Engineers

Despite the fact that the preceding analysis shows that the returns received from older and younger engineers can be accepted as representative of each of the groups within the engineering profession, the disproportion in the numbers of each group reporting requires further consideration.

The census of 1930 reported 226,136 technical engineers as of April 1, 1930. Assuming that engineers in each age group in 1930 experienced the same mortality as the general male population between 1930 and 1935, as indicated by estimates of population in 1935 made by the Bureau of the Census, 13,336 engineers would have died before the questionnaires for the present survey were mailed. This would leave in 1935 a total of 212,800 engineers who had been in the profession in 1930. Usable returns were received from 33,841, or 15.9 percent.

From returns to the Office of Education of first degrees to graduates from engineering colleges and universities from 1930–34, it is estimated that 51,303 persons prepared to enter the profession. Of these, 50,508 might have been expected to survive to 1935. Usable returns were received from 18,267, or 36.2 percent of the 50,508.

It is evident from these figures that this younger group is more heavily represented in the returns than the older group. A detailed examination of the returns by the older group revealed no tendency toward more complete coverage in the lower ages of this group. Nor did 1932 or 1934 graduates differ materially from 1930 graduates in the proportion of their number who responded. These facts lead to the belief that the response of 16 percent by older engineers as against a 36 percent response by younger engineers does not indicate a true difference in the tendency of engineers of different ages to return the questionnaires. On the other hand, older engineers were canvassed only if they had been known to some engineering society, while younger engineers were approached through comprehensive lists of graduates many of whom, however, were members of engineering societies. There is every reason to believe that the questionnaire reached a larger proportion of the recent graduates than of the engineers who had been in the profession in 1929. It is reasonable to assume that in each group approximately the same proportion of those canvassed responded.

This difference in the proportion covered does not affect separate analyses of the group of younger and older engineers. But where an attempt is made to describe the profession as a whole in 1932 or 1934, the picture is distorted by the overrepresentation of the younger graduate group. As there were more than 18,000 returns from such men out of a total of about 52,600, it seriously distorts the balance to

overrepresent the younger group in the ratio of about 2 to 1, or by more than 9,000.

No perfect adjustment of the sample is possible. The important thing was that the number of returns from younger engineers be cut approximately in half before they were combined to present a composite picture of the professions. Actually in this case the various tabulated totals for engineers graduating in 1930–34 were reduced by 53.1 percent before they were combined with reports for all "other" engineers or earlier graduates. In effect this reduced the number of returns for 1934 from 52,589 to a more balanced sample of 42,787. Similarly, in 1932 the unadjusted number of reporting engineers was 45,141, as against an adjusted total of 39,277. The importance of some such adjustments may be seen from the fact that the median monthly rate of compensation in 1934 for all engineers engaged in engineering work is $210 for the adjusted sample, as against $189 had there been no adjustment for the overweighting of new entrants to the profession.[14]

[14] There are too many unknown facts to allow the adjustment to be more than an approximation. For example, no allowance could be made for retirements from the profession. It is, however, a useful check on the processes of statistical reasoning that lead to approximate results, to arrive at an adjustment factor step by step. Such a process leads in this case to the conclusion that there had been 15.9 percent reporting by one group, 36.2 percent reporting by another, and that returns from the latter group could well be reduced by 56.0 percent to be in approximate balance with the returns by the former group. In point of fact, the adjustment factor used in this report is 53.1 percent. This figure was derived early in the study, since which time new collateral data have become available; it is retained to avoid the confusion of unimportant changes in tables already published in the Monthly Labor Review. For example, the average of $210 which has been published would be changed to $213.

Chapter II

The Growth of the Engineering Profession, 1910 to 1934

The materials collected in this study deal only with the period 1930–34, but other data make it possible to trace the growth of the engineering profession against the background of that which occurred from 1910 to 1930.

From 1910 to 1930, the number of technical engineers as reported by the Census of Occupations increased from 88,744 to 226,136. This included an increase of some 53.3 percent for the decade 1910–19, during which time the absolute numbers increased from 88,744 to 136,080. In the decade 1920–29 the increase was 66.2 percent. This growth, however, requires further consideration.

The 1930 Census of Occupations also shows a category of designers, draftsmen, and inventors, embracing 93,518 males. Some of these men were obviously eligible for membership in one or another of the engineering societies, and especially so in view of the fact that many college graduates serve an apprenticeship as draftsmen. Since persons so reporting were not included in the census returns as technical engineers, the consequence was to lower the number reported by the census who regarded themselves as in the profession in 1930. But all persons in this census category cannot be considered exclusively as subprofessional to engineering. For example, dress designers are included as designers, while bridge designers should be excluded and classified as technical engineers. Draftsmen in an architect's office and in the design room of a machine-tool establishment are lumped together.

It is, however, worth noting that the number of male draftsmen grew so nearly at the same rate as the number of technical engineers from 1910–19 and again from 1920–29 that conclusions based on rates of growth for technical engineers alone may be accepted.

The main question is whether or not the absolute growth in the number of technical engineers as shown by the census may be accepted. Representatives of the engineering profession incline to the belief that there is a tendency to overreport professional status to the census enumerator and thus to inflate the number reported to be technical engineers. There is no way to tell whether or not there

were in fact 226,000 technical engineers in 1930, but it does appear probable that the indicated net growth of 90,000 occurred from 1919–29.

The census shows 32,020 technical engineers 45 years of age or more in 1920 and 21,822 engineers 55 years of age or more in 1930. (By professional class the figures for 1920 and 1930, respectively, are: Civil engineers, 15,111 and 10,768; electrical engineers, 4,734 and 3,471; mechanical engineers, 9,894 and 5,896; and mining engineers, 2,281 and 1,687.) It may fairly be assumed that so few people entered the profession at these ages from 1920–29 that the net loss of 10,200 at this age level may be accepted as representing death and retirement. Since there are substantial numbers of new entrants to the profession at lower ages, it is not possible to assume that the loss can be estimated for the group 20–44 years of age in 1920 by comparing it with the group 30–54 years of age in 1930. Rather some estimate must be made of the number of deaths and disability retirements that would probably have occurred out of the 103,875 technical engineers reporting in 1920 at these ages.

The age distribution of the 1920 data is in intervals too wide to permit of a reasonable estimate of probable survivals. On the other hand, it may be assumed that comparatively few male workers enter the labor market for the first time after they are 25, and that the disappearance of engineers will approximate that for the total male population within the age limits under discussion. There were 10,637,000 native white male workers in 1920 who were 25–44 and 10,246,000 in 1930 who were 35–54, a decrease of 3.7 percent. Applying this ratio to the 103,875 engineers who were 20–44 in 1920, there would have been a disappearance through death or disability of 3,800, making a total loss in both groups of about 14,000.

Allowance cannot be made for two offsetting forces: The entrance of men who were technical engineers in 1920 into nonengineering work in 1930; the recruiting of technical engineers by 1930 from among men who were in subprofessional occupations in 1930. The residual of these two opposite tendencies is probably small enough to be disregarded without invalidating general conclusions.

Essentially, therefore, gross additions of 104,000 technical engineers between 1920 and 1930 have to be accounted for—14,000 replacements and a net growth of 90,000. This represents net additions per year of 10,400 men employed as technical engineers.

The largest source of supply was the influx of college graduates. The Office of Education has reported biennially graduates with first degrees in engineering. Interpolating graduations for the other years, it may be estimated that about 75,000 degrees were awarded in the academic years 1919–20 to 1928–29. In passing, be it noted

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that the range in the estimate is from 74,600 to 75,600 because 1920–21 degrees may be estimated to fall either midway between those graduated in 1919–20 and 1921–22, or it may be assumed that the increase from 1920–21 to 1921–22 was like that in the following year. (See appendix D, p. 233, table 1.)

Not all of these men entered or remained in engineering. In the sample obtained by the Bureau, 5.6 percent of the graduates of the classes 1920–29 (who were also past or present members of engineering societies) reported that they were in nonengineering work. They would probably have reported some other occupation to the census in 1930 than that of technical engineering. Hence, the influx of technical engineers by 1930 from college graduates was probably about 70,440.

This disregards two facts—that a negligible number of these engineers died before 1930 and that some of the graduates in the later classes may still have been serving a subprofessional apprenticeship in 1930. It is safe to assume that many of these would have called themselves engineers. Moreover, professional engineering societies accept them in membership.

In any event, the 70,440 graduates embrace 67.7 percent of the 104,000 engineers who apparently entered the profession from 1920–29. In other words, 32.3 percent must have included men without college degrees in engineering. In point of fact, the returns show that of all men reporting for this decade and who had engineering jobs in 1929, some 29 percent comprised both nonengineering graduates and "other" or nongraduate engineers. Or if the engineering graduates comprise 71 percent of the total number entering in this decade, it is possible to account for the entrance into the profession of about 99,210 technical engineers. It is of course possible that the sample obtained by the Bureau in 1935 underestimates nongraduate engineers entering in this decade by about 3.3 percent and is probably accounted for by the fact that the younger group of nongraduate engineers are less likely to join engineering societies than graduates. At all events the reasonableness of the census figure of growth leads to the possible inference that the absolute total as a whole is also reasonably representative.

From 1930–34, reports made in the present survey indicate a growth of 26.4 percent. The adjusted data presented in table 5 show that between the end of 1929 and 1934 the number of engineers in the sample increased from 33,841 to 42,787.[1]

From the preceding figures it appears therefore that the annual influx in absolute numbers during the two periods was quite similar. It is estimated that in the twenties there was an average gross influx

[1] The indicated growth of 26.4 percent makes no allowance for active engineers in 1929 who died or retired by 1935 and did not respond to the questionnaire.

of about 11,300 per year.[2] In 1930–34, the average as estimated from graduations reported by the Office of Education and from the sample for nongraduates [3] was about 10,300.

Despite this similarity in annual influx, however, the rate of influx of technically trained engineers during the depression was slightly less than it had been in the decade of the twenties. In that decade the profession was growing at the compound rate of about 5¼ percent a year. This was the growth in the number practicing the profession or regarding themselves as engineers even though unemployed and classified as technical engineers in the census of 1930. In addition, slightly more than one-twentieth of those trained in college and receiving engineering degrees were going into nonengineering fields of employment. If for comparison with the growth in 1930–34, this latter group be regarded as engineers, or at least as part of the gross annual addition to the supply of engineers, the number of engineers in the period 1920–29 was growing at the compound rate of about 5¾ percent. In the period from 1930 to 1934, the compound rate of growth was 4¾ percent.

TABLE 5.—*Graduates* [1] *and "other" engineers* [2] *reporting at end of 1929, 1932, and 1934*

[Figures adjusted as explained on p. 34]

Item	Number			Percentage		
	Total	Graduates [1]	"Other" engineers [2]	Total	Graduates [1]	"Other" engineers [2]
Professionally active in 1934	42,787	33,486	9,301	100.0	78.3	21.7
Professionally active in 1932	39,277	30,012	9,265	100.0	76.4	23.6
Professionally active in 1929	33,841	24,826	9,015	100.0	73.4	26.6
Entered profession 1933–34	3,510	3,474	36	100.0	99.0	1.0
Entered profession 1930–32	5,436	5,186	250	100.0	95.4	4.6
Professionally active in 1929	33,841	24,826	9,015	100.0	73.4	26.6

[1] Graduate engineers include all postgraduates, nonengineering graduates, and first-degree engineering graduates.
[2] "Other" engineers include all engineers with college course incomplete, noncollegiate technical school course, and secondary school education.

The third point to be noted has regard to the marked change in the source of supply of engineers in the two periods. From 1920–29 there was an annual absorption of 10,400 engineers in engineering jobs and an average of college-degree awards of only 7,500. Furthermore, the engineering profession had to compete for the services of these graduates with nonengineering groups. There was room then for men with a few years of college training.

In the depression years, however, these conditions did not prevail, for the colleges were supplying as many engineers with degrees as

[2] The basis of estimation accounts for an annual addition of 10,400 engineering jobs. Also counted in the text are about 900 or 1,000 college graduates each year who went into nonengineering work.
[3] Includes nonengineering graduates and "other" or nongraduate engineers reporting.

were supplied in the twenties from all sources. The number of first degrees awarded rose sharply, averaging more than 10,200 and reaching 11,421 in 1933–34. On the other hand, only 481 of the 18,748 reporting engineers entering the profession from 1930–34 did not have college degrees in engineering. Yet, it has been noted that the main source of supply of nongraduates in the twenties was from among those with an incomplete college course.

This sharp contrast makes permissible the statement that the extremely small number of such men reporting in the depression period does not represent underreporting. It may well reflect a profession effectively closed to all but men with engineering degrees, and more especially so when such a supply was more than adequate to meet current demand.[4]

This raising of educational standards appears to be definitely related to the change in the relationship of the demand for professional services to the supply of trained engineers. What this change meant, and also what occurred in the growth in numbers of professional engineers in terms of employment and unemployment, is developed in the following chapters.

[4] In this regard, analysis of the figures of the Office of Education shows that during the decade of the twenties slightly less than half of the enrollees were graduating. But while enrollment decreased from 74,000 in 1929–30 to 62,601 in 1933–34, degrees awarded increased from 8,947 to 11,421 (appendix D, p. 233, table 1). It is most unlikely that engineering schools as a whole ever "flunked out" half of the total enrollment (not merely the freshman class) or seriously lowered standards during the depression. It seems probable that "college course incomplete" as the educational background of an engineer meant, in a great number of cases, a man who had found a job after a year or so of college work. If educational requirements were raised by employers during the depression, he stayed on in school if he could.

Chapter III

Educational Qualifications of Professional Engineers

Educational Requirements and Professional Engineering Status

If membership in an engineering society be accepted as a measure of professional status, the reports furnished by engineers in this survey clearly indicate that formal engineering education was not the sole method of obtaining such a status. Thus, the data in table 6 show that some 69.4 percent of the 42,683 engineers reporting for 1934 specified that they had first degrees in engineering, while 5.8 percent also reported postgraduate work. Another 2.8 percent graduated from liberal arts colleges usually with a major in mathematics, physics, or chemistry. In later analyses these three groups are discussed together. But some 21.8 percent of the engineers had

TABLE 6.—*Distribution at end of 1934 of engineers in the 9 professional classes reporting, in by type of education*

[Figures adjusted as explained on p.34]

Type of education	Total	Professional class								
		Agricultural	Architectural	Ceramic	Chemical	Civil	Electrical	Industrial	Mechanical	Mining and metallurgical
	Number									
All types	42,787	325	408	300	2,410	17,020	8,926	743	10,802	1,853
First-degree engineering graduates	29,708	235	259	232	1,665	11,291	6,564	518	7,630	1,314
Postgraduates	2,486	50	17	28	377	679	638	26	498	173
Nonengineering graduates	1,188	12	28	14	186	426	190	29	218	85
College course incomplete	5,651	17	67	15	154	2,951	862	97	1,299	189
Noncollegiate technical school	2,684	5	26	6	20	1,124	517	52	879	55
Secondary school	966	6	6	5	3	510	140	18	245	33
Not reporting	107	.....	5	.....	5	39	15	3	33	4
	Percentage									
All types	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
First-degree engineering graduates	69.4	72.3	63.4	77.3	69.1	66.4	73.5	69.7	70.7	70.9
Postgraduates	5.8	15.4	4.2	9.3	15.7	4.0	7.2	3.5	4.6	9.3
Nonengineering graduates	2.8	3.7	6.9	4.7	7.7	2.5	2.1	3.9	2.0	4.6
College course incomplete	13.2	5.3	16.4	5.3	6.4	17.3	9.6	13.1	12.0	10.2
Noncollegiate technical school	6.3	1.5	6.4	1.7	.8	6.6	5.8	7.0	8.1	3.0
Secondary school	2.3	1.8	1.5	1.7	.1	3.0	1.6	2.4	2.3	1.8
Not reporting	.2	.....	1.2	.....	.2	.2	.2	.4	.3	.2

attained professional status through following a less formal training. Three-fifths of this group had attended engineering schools but had not completed the college course. The "other" or nongraduate engineers included 967 men whose education did not extend beyond graduation from a secondary school; the majority of these were professionally active prior to 1930.

The indication from the preceding analysis that experience did affect the obtaining of professional status makes possible some explanation of the small returns from "other" or nongraduate engineers for the period 1930–34. These, it will be recalled, covered but 1 percent of all younger engineers reporting. On the other hand, among the older engineers the proportion so classified was 26.6 percent. Thus, it appears that there is a "time lag" during which the "other" or nongraduate engineers have to obtain sufficient experience to offset the lack of formal engineering education.

Educational Specialization by Professional Class

While first-degree graduates predominate in all professional classes, chart 3 reveals that there are marked variations as regards educational background among the several professional classes. For example, the lowest proportion of first-degree engineering graduates embraced 63.4 percent of the 408 architectural engineers, while the highest proportion covered 77.3 percent of the 300 reporting ceramic engineers.

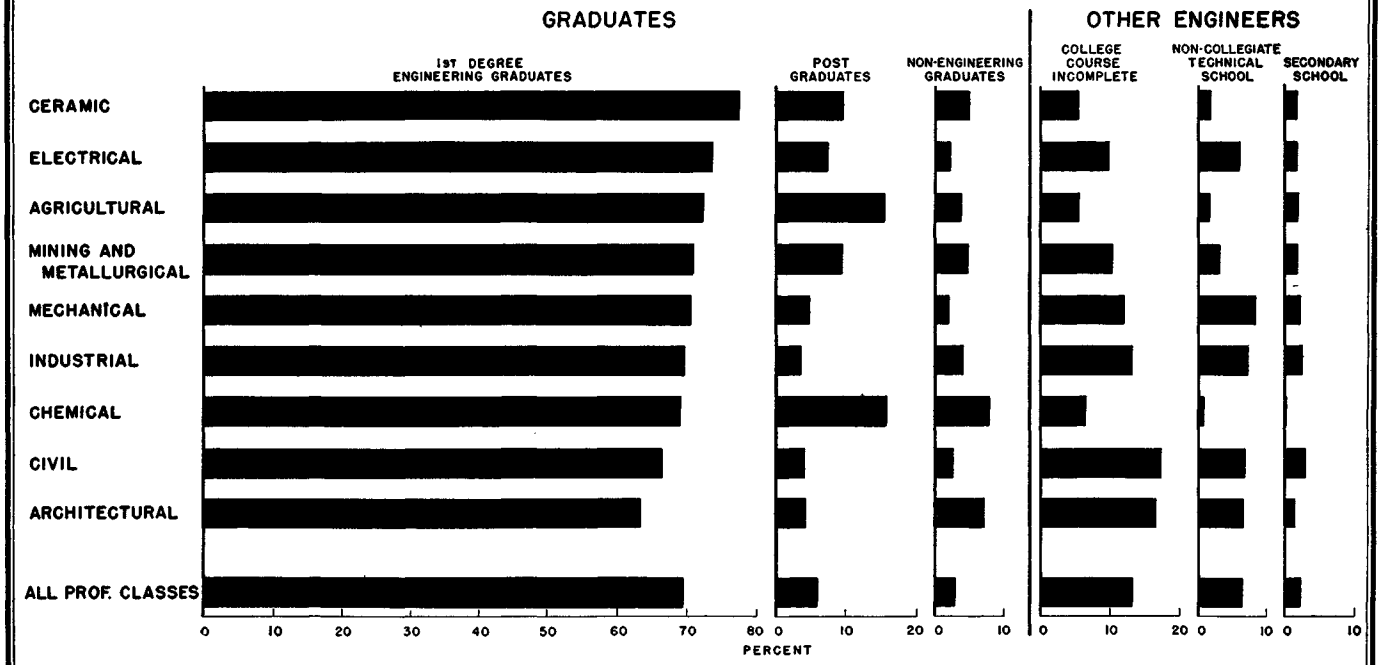
In the case of engineers with postgraduate training there are reflected differences in the demand for a still higher degree of educational specialization and for a more elaborate training. Some 15.4 percent and 15.7 percent, respectively, of the agricultural and chemical engineers had postgraduate degrees, and 9.3 percent in the case of both ceramic and mining and metallurgical engineers. Next in order came electrical engineers with 7.2 percent reporting postgraduate work. The range among the other four professional classes was from 3.5 percent for industrial engineers to 4.6 percent for mechanical engineers.

The opportunities for specialization for the several professions in colleges other than engineering schools differ. This is partially reflected in the relative distributions of the nonengineering graduates. Thus, in chemical engineering, it will be noted that this type of education embraced 7.7 percent of this class and was as high as 6.9 percent for architectural engineering. Among the other professional classes the proportions ranged from 2.0 percent for mechanical engineers to 4.7 percent in the case of ceramic engineers.

Consideration of the reports from "other" or nongraduate engineers more clearly emphasizes the insistence upon rigid engineering education as a prerequisite to engineering experience. Thus, of engineers

CHART 3

NATIONAL DISTRIBUTION OF THE NINE PROFESSIONAL CLASSES BY TYPE OF EDUCATION-1934



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with college courses incomplete, relatively the lowest proportions are to be found in agricultural, ceramic, and chemical engineering, and ranged from 5.3 percent to 6.4 percent. But among the other professional classes the range was from 9.6 percent of the electrical engineers to as high as 17.3 percent of the civil engineers. A similar situation is to be noted in the distributions by professional class of engineers with noncollegiate technical school training and those with no education reported beyond secondary school.

Trends in Educational Background

Further consideration of the data permit of deriving certain findings in regard to two trends concerning educational background. First, a comparison by corresponding age groups of the reports from "other" or nongraduate engineers reveals a distinct tendency for formal college education to become a prerequisite to attaining professional engineering status. Thus from the data presented in table 7 it will be noted that 34.3 percent of the reporting engineers born prior to 1875 entered the profession without a college degree. This percentage decreases steadily and was 28.1 percent among engineers born in 1885–94 and 25.7 percent among those born in 1895–99 and graduating from college in 1918–27.

TABLE 7.—*Percentage "other" engineers formed of older* [1] *engineers reporting year of birth*

Year of birth	Age in 1929	Total reporting	"Other" engineers	Percentage "other" engineers
Total		33,494	9,015	26.9
1905–9	20–24	4,004	1,049	(2)
1900–4	25–29	6,456	1,384	21.4
1895–99	30–34	5,452	1,401	25.7
1885–94	35–44	10,049	2,826	28.1
1875–84	45–54	5,603	1,693	30.2
Prior to 1875	55 and over	1,930	662	34.3

[1] Includes those engineers who reported they were professionally active prior to 1930.

[2] The percentage for the figures as shown is 26.2. The 1,049 "other" engineers in this group were professionally active in 1929. It is to be noted that returns from graduate engineers were tabulated not by age but by year of graduation on the assumption that they were 23 years of age at graduation. Therefore, for strict comparability, the 1905–9 group ought also to include engineering graduations in the period 1930–32. Were this done, the adjusted total reporting in this age group would be 9,052, of which number the 1,049 "other" engineers would comprise 11.6 percent. This percentage, however, may overemphasize the shift which occurred in the change in the proportion with time of "other" engineers in the profession. Certainly the trend appears to have been continuous, but it may be expected that some additions will be made from these age groups among "other" engineers as they mature in their work.

Furthermore, within the several "other" or nongraduate types of educational background there have been distinct shifts. (Table 8.) Thus, among the 1,293 engineers born prior to 1880 who had not received a college degree 587, or 45.4 percent, were secondary-school graduates or attended noncollegiate technical schools. Among those born from 1895–1904 only about one-third had such a background, the others being engineers who did not complete a college course. The

highest percentage (17.1) of engineers with only secondary-school education embraced men born in the years 1885–89. For noncollegiate technical school engineers the peak was reached some 5 years later. By contrast, it is significant to note that the highest percentage for engineers with college courses incomplete embraced men born in the period 1900–4, or some 10 years later than that noted for noncollegiate technical school engineers. This situation may also reflect the retention of memberships in engineering societies by engineers with incomplete college courses which were obtained during their attendance at engineering schools.

TABLE 8.—*Number at end of 1934 of "other" engineers reporting, by age and specific type of education*

Born in period	Total	College engineering course incomplete	Noncollegiate technical school	Secondary school	Total	College course incomplete	Noncollegiate technical school	Secondary school	College course incomplete	Noncollegiate technical school	Secondary school
	Number				Percentage						
					In each age group				In each type of education		
Total	9,301	5,651	2,683	967	100.0	60.8	28.8	10.4	100.0	100.0	100.0
1874[1]	662	358	187	117	100.0	54.1	28.2	17.7	6.3	7.0	12.1
1875–79	631	348	200	83	100.0	55.2	31.6	13.2	6.1	7.4	8.6
1880–84	1,062	596	358	108	100.0	56.1	33.7	10.2	10.5	13.4	11.1
1885–89	1,406	789	452	165	100.0	56.2	32.1	11.7	14.0	16.8	17.1
1890–94	1,420	792	476	152	100.0	55.7	33.6	10.7	14.0	17.8	15.7
1895–99	1,401	898	375	128	100.0	64.1	26.8	9.1	15.9	14.0	13.2
1900–4	1,384	915	360	109	100.0	66.1	26.0	7.9	16.2	13.4	11.4
1905–9	1,049	737	224	88	100.0	70.3	21.3	8.4	13.1	8.3	9.1
1910–14	286	218	52	16	100.0	76.2	18.2	5.6	3.9	1.9	1.7

[1] Or earlier.

Growth of Postgraduate Work in Engineering

The second trend to be considered has regard to the growth of postgraduate training in engineering. Thus, the proportions who sought postgraduate work embraced 6.6 percent of all engineers reporting in the graduating classes prior to 1905. (Table 9.) Of the classes of 1905–9 the proportion was lower, namely 5.9 percent. Thereafter there was a steady increase from 7.1 percent of the 1910–14 classes to 8.6 percent of those who graduated in the years 1920–24, and to 10.2 [1] percent of those graduating in 1925–29. Clearly, there has been a steady growth in postgraduate work in engineering. The preceding analysis, however, showed that postgraduate work is extensive in but a few professional classes.

[1] The increase to 10.2 percent noted must be qualified, for it is highly probable that it reflects not only a rising trend of the past but also the lack of engineering employment in the period 1930–34. Rather than remain unemployed many engineering students continued their studies, a situation which may also have affected engineers of the graduating classes 1933–34.

The decline in the ratio of postgraduate degrees among those graduating in 1930–34, as the detailed figures in the table show, is no more than a reflection of lack of time to complete graduate training.

TABLE 9.—*Number of professional engineers reporting postgraduate degrees in engineering at end of 1934*

[Figures adjusted as explained on p. 34]

Year first degree was obtained [1]	Total advanced degrees	Total engineering graduates	Percentage advanced degrees formed of total engineering graduates
Total	2,486	33,382	7.4
1930–34	473	8,634	5.5
1925–29	662	6,482	10.2
1920–24	433	5,034	8.6
1915–19	260	3,225	8.1
1910–14	257	3,616	7.1
1905–9	178	3,032	5.9
Prior to 1905	223	3,359	6.6
1934	14	1,675	.8
1933	77	1,794	4.3
1932	134	1,832	7.3
1931	137	1,738	7.9
1930	111	1,595	7.0
1929	162	1,647	9.8
1928	133	1,255	10.6
1927	123	1,185	10.4
1926	122	1,172	10.4
1925	122	1,223	10.0

[1] In the case of the graduating classes 1933-34, the year shown is that in which the advanced degree was obtained.

The Extent of Transfers from Original Courses of Specialization

In this section consideration is given to an aspect of engineering education which apparently has been of some concern to the profession, namely, to what extent do engineers transfer from their original course of specialization to other fields of activity.

At first glance the fact that 11.1 percent of the 31,839 reporting graduates stated that they had transferred from their original course of specialization appears significant. (Table 10.) But when consideration is given to the relative proportions so reporting within each professional class, it will be noted that the tendency to transfer was least for ceramic, chemical, and electrical engineers, in that the proportions practicing in these fields who had received a degree in another ranged from only 4.4 percent to 6.5 percent. Among architectural and civil engineers the proportions were approximately the same, namely, 12.7 and 11.0 percent, respectively, while a similar correspondence will be noted in the case of mechanical and mining and metallurgical engineers with 14.7 percent and 15.7 percent, respectively. On the other hand, in the case of agricultural engineers 31.3 percent, and in the case of industrial engineers no less than 51.0 percent, reported some other field of specialization in college.

TABLE 10.—*Number of engineers at end of 1934 reporting college course same as and different from professional class*

[Figures adjusted as explained on p. 34]

Item	Total [1]	Professional class								
		Agricultural	Architectural	Ceramic	Chemical	Civil	Electrical	Industrial	Mechanical	Mining and metallurgical
	Number									
Total [1]	31,839	284	276	260	2,029	11,857	7,118	529	8,006	1,480
Course same as professional class reported	28,290	195	241	243	1,918	10,552	6,802	259	6,833	1,247
Course different from professional class reported	3,549	89	35	17	111	1,305	316	270	1,173	233
	Percentage									
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Course same as professional class reported	88.9	68.7	87.3	93.5	94.5	89.0	95.6	49.0	85.3	84.3
Course different from professional class reported	11.1	31.3	12.7	6.5	5.5	11.0	4.4	51.0	14.7	15.7

[1] The total includes first-degree graduates and those reporting postgraduate work in engineering as shown in table 6 exclusive of 355 reports covering men with (a) degrees in business administration, (b) courses in fields other than engineering, and (c) advanced degrees in other fields.

Since the lowest proportions reporting change were among ceramic, chemical, and electrical engineers, it is evident that some conditioning factor must have affected these professional groups to keep the proportions so low. The obvious answer is, of course, specialization. On the other hand, the excessively high proportion reporting a change among agricultural and industrial engineers need not necessarily be interpreted as one arising from change in activity as so much one in change of name. It is, of course, well known that mechanical and industrial engineering are closely correlated. Furthermore, industrial engineering as a professional class was a much later development than mechanical engineering. Therefore, it would obtain its source of supply from men who had been trained or graduated in mechanical engineering before engineering colleges began to teach specialized courses in industrial engineering. Similar remarks also apply to agricultural engineering, in that this field is closely allied to civil engineering.

Despite the fact that, apparently, transfers among engineers is not extensive, the subsequent discussion of employment in the engineering profession does reveal certain aspects which might affect the programs of engineering education, for this analysis shows distinct shifts in regard to work of a nonengineering nature.

Chapter IV

Employment in the Engineering Profession, 1929 to 1934

Supply and Demand for Engineering Services, 1929 to 1934

Employment Status of All Professional Engineers [1]

Between December 1929 and December 1932 the total number of professional engineers in the sample increased by 4,439, from 31,252 to 35,691. (Table 11.) There was a further increase of 3,470 to 39,161 by December 1934. Thus there was a quarter again as many men with engineering training at the end of 1934 as at the beginning of the depression.[2]

TABLE 11.—*Employment status at end of 1929, 1932, and 1934 of all engineers reporting*

[Figures adjusted as explained on p. 34]

Employment status	Number			Percentage			Increase or decrease in number		
	1929	1932	1934	1929	1932	1934	1929 to 1932	1932 to 1934	1929 to 1934
Total	31,252	35,691	39,161	100.0	100.0	100.0	+4,439	+3,470	+7,909
Engineering employment	29,051	27,787	30,299	93.0	77.9	77.4	−1,264	+2,512	+1,248
Private [1]	22,456	19,797	20,619	71.9	55.5	52.7	−2,659	+822	−1,837
Public [2]	6,595	7,990	9,680	21.1	22.4	24.7	+1,395	+1,690	+3,085
Nonengineering employment	1,969	4,290	5,523	6.3	12.0	14.1	+2,321	+1,233	+3,554
Unemployment	232	3,614	3,339	.7	10.1	8.5	+3,382	−275	+3,107

[1] Includes employees of private firms, independent consultants, "any other employment," and teaching.
[2] Includes employees of Federal, State, county, and municipal Governments, and other public authority.

[1] For these particular purposes, there are utilized the data as derived from the reports furnished as answers to question 6 of the questionnaire, in which the engineer was requested to check his employment status against only 1 of 14 items for each of the 3 years ending Dec. 31, 1929, 1932, and 1934. In view of the small number reporting in some categories, similarity in the detailed distributions, and the desirability of discussing unemployment and related data as a whole, these 14 categories were reduced to 8 and are designated thus: (1) Private firm (includes also those reporting as employees of private consulting firms and under "any other employment" in question 6), (2) independent consultant, (3) teaching, (4) Federal, (5) State and county, (6) municipal and other public authority, (7) nonengineering employment, and (8) gross unemployment (i. e., includes those reporting unemployment, on work relief, or on direct relief). In the ensuing discussion items (1) to (3) inclusive, and (4) to (6) inclusive are hereafter referred to, respectively, as private engineering employment and public engineering employment, and these 2 in combination as total engineering employment.

[2] This increase of 25.3 percent in table 11 differs by 1.1 percent from that of 26.4 percent noted in the discussion of the growth of the profession. This difference is explained by the fact that in tabulating the data on employment status homogeneity of the sample of older and 1930–32 engineers was maintained. That is, in the case of the former, only those reporting for the 3 years 1929, 1932, and 1934 were used; in the case of the latter, only those reporting for the 2 years 1932 and 1934 were included. While the difference between the two percentages obviously does not materially affect the analysis, it does indicate that the percentage of engineers eliminated from the tabulation was small.

This increase took place during 5 years of depression in which there was at first an actual shrinkage in engineering opportunities. Engineering employment as a whole declined 4.4 percent between 1929 and 1932. There was a rise by December 1934. The number in the adjusted sample engaged in engineering work increased from 29,051 in December 1929 to 30,299 in December 1934.

The result was a large amount of unemployment and an intense pressure to find nonengineering work. For December 1932, 3,614 reported that they were unemployed. The percentage of those reporting unemployment declined from 10.1 at the end of 1932 to 8.5 at the end of 1934. But in the face of the continuing influx of engineers, the absolute number of those unemployed declined only slightly, to 3,339 at the end of 1934.

Furthermore, the amount of unemployment was held at these levels only because large numbers of trained engineers went into nonprofessional work. While the presence of 6.3 percent of the professional engineers in nonengineering employment in 1929 indicates this was even then an established and normal outlet for them, there was an enormous increase in such work between 1929 and 1932. There was a further, but smaller, increase in nonengineering work between 1932 and 1934. The number reporting themselves as engaged in such work increased from 1,969 in 1929 to 5,523 by December 1934. Among the engineers reporting, 12.0 and 14.1 percent were engaged in nonengineering work in December 1932 and 1934, respectively. In the subsequent analyses of the income data, it will be seen that the specific nonengineering work of many of those reporting in 1934 was much more frequently of a makeshift character than in 1929.

Had it not been for the large increase in the employment of engineers by public authorities, the effect of the depression would have been even more disastrous. Private employment decreased by 11.8 percent from 1929 to 1932. Despite some increase from 1932 to 1934, it was still 8.2 percent below the 1929 level at the end of the 5-year period 1930–34. The dependence upon public employment is further evidenced by the fact that although both classes of engineering employment increased between December 1932 and December 1934, the absolute increase reported in private employment was only half of that obtaining in employment with public authorities. Relative to the numbers so employed in 1932, the rate of increase in public employment was almost five times as great as that in private employment.

Employment Status of Five Professional Classes

The preceding analysis was concerned with the engineering profession as a whole. Corresponding adjusted data are presented in table 12 for each professional class.

TABLE 12.—*Employment status at end of 1929, 1932, and 1934, of all engineers reporting, by professional class*

[Figures adjusted as explained on p. 34]

Professional class	Number of engineers								
	Total			In engineering employment					
				Total private [1]			Total public [2]		
	1929	1932	1934	1929	1932	1934	1929	1932	1934
All classes	31,252	35,691	39,161	22,456	19,797	20,619	6,595	7,990	9,680
Chemical and ceramic	1,470	1,931	2,389	1,217	1,322	1,640	103	122	143
Civil, agricultural, and architectural	13,786	15,330	16,365	7,477	5,760	5,191	5,510	6,620	7,941
Electrical	6,112	7,276	8,117	5,238	4,940	5,137	350	456	623
Mechanical and industrial	8,455	9,587	10,609	7,374	6,729	7,512	504	643	802
Mining and metallurgical	1,429	1,567	1,681	1,150	1,046	1,139	128	149	171

Professional class	Number of engineers					
	In nonengineering employment			Unemployed [3]		
	1929	1932	1934	1929	1932	1934
All classes	1,969	4,290	5,523	232	3,614	3,339
Chemical and ceramic	143	320	459	7	167	147
Civil, agricultural, and architectural	694	1,413	1,556	105	1,537	1,677
Electrical	493	1,155	1,759	31	725	598
Mechanical and industrial	517	1,190	1,518	60	1,025	777
Mining and metallurgical	122	212	231	29	160	140

[1] Includes employees of private firms, independent consultants, "any other employment," and teaching.
[2] Includes employees of Federal, State, county, and municipal Governments, and other public authority.
[3] Includes direct relief and work relief.

While the total number of engineers during the 5-year period ending December 1934 increased by 25.3 percent, the corresponding increases for the separate professional classes ranged from 17.6 percent for mining and metallurgical engineers to 62.5 percent in the case of chemical and ceramic engineers. (Table 13.)

TABLE 13.—*Percentage change 1929 to 1934 in engineering employment, by professional class*

[Figures adjusted as explained on p. 34.]

Professional class	Percentage increase in each professional class, 1929–34	Percentage increase or decrease, 1929–34 in—		
		Total engineering employment	Private [1] engineering employment	Public [2] engineering employment
All classes	+25.3	+4.4	−8.2	+46.8
Mining and metallurgical	+17.6	+2.5	−1.0	+33.6
Civil, agricultural, and architectural	+18.7	+1.1	−30.6	+44.1
Mechanical and industrial	+25.5	+5.5	+1.9	+59.1
Electrical	+32.8	+3.1	−1.9	+78.0
Chemical and ceramic	+62.5	+35.1	+34.8	+38.8

[1] Includes employees of private firms, independent consultants, "any other employment," and teaching.
[2] Includes employees of Federal, State, county, and municipal Governments, and other public authority.

In no professional class did total engineering employment keep pace with the growing number of engineers. The closest balance between the increase in number of engineers and the increase in total engineering employment was 62.5 percent to 35.1 percent for chemical and ceramic engineers. That is, without displacement of engineers already in the profession in 1929 about half of the increased number of chemical engineers could have been absorbed in engineering work. The next highest increase in number of persons trained for engineering work occurred among electrical engineers, among whom there was an increase of 32.8 percent. This was met by an increase of only 3.1 percent in the total number employed as engineers. Mechanical and industrial engineers fared somewhat better. Their numbers increased by 25.5 percent, while opportunities for engineering employment increased by 5.5 percent. Roughly, one-fifth of the total increase in number of all engineers between 1930 and 1934 was provided for by the growth of new jobs. Clearly, the wide variations in the rates of increase in these professional classes had an important bearing upon the nature of their employment distributions in the period 1929–34.

The data for private and public engineering in table 13 accentuate the differences in available engineering opportunities for each professional class. Thus over the 5-year period, although private engineering employment for all engineers considered as a group declined by 8.2 percent, it increased by more than a third for chemical and ceramic engineers. There was little increase or decrease for electrical, mining and metallurgical, and mechanical and industrial engineers; but in the case of the civil engineers, there was a decrease of about one-third in private engineering employment.

By contrast, no professional class was excepted from the increases which took place in public engineering employment. It was, however, the civil engineers who were most affected. For them public employment was an important field in 1929 when 40 percent of all civil engineers were so engaged. The 44.1 percent increase by 1934 in the amount of such employment reported meant an absolute increase of 2,431 jobs over the 5-year period in the sample covered. In contrast, less than 6 percent of electrical and mechanical engineers had been employed by public authorities in 1929. By December 1934, although the numbers of them so engaged had increased by 78.0 and 59.1 percent, respectively, the absolute increases in jobs reported were only 273 for electrical and 298 in the case of mechanical and industrial engineers. For chemical and ceramic, and mining and metallurgical engineers, the absolute increases were, respectively, 40 and 43.

Since the available engineering opportunities did not keep pace with the increases in men trained to enter the profession, there must obviously have been changes in the proportions, first, of those engaged in engineering and second, of those unemployed, or engaged in nonengi-

neering work. This is evidenced by considering the adjusted data presented in table 14.

TABLE 14.—*Percentage distribution of employment status at end of 1929, 1932, and 1934 of engineers reporting, by professional class*

[Figures adjusted as explained on p. 34]

Professional class	Percentage total in each professional class reporting—											
	Engineering employment						Nonengineering employment			Unemployment [3]		
	Private [1]			Public [2]								
	1929	1932	1934	1929	1932	1934	1929	1932	1934	1929	1932	1934
Total, United States	71.9	55.5	52.7	21.1	22.4	24.7	6.3	12.0	14.1	0.7	10.1	8.5
Chemical and ceramic	82.8	68.5	68.7	7.0	6.3	5.9	9.7	16.6	19.2	.5	8.6	6.2
Civil, agricultural, and architectural	54.2	37.6	31.8	40.0	43.2	48.5	5.0	9.2	9.5	.8	10.0	10.2
Electrical	85.6	67.8	63.1	5.8	6.3	7.8	8.1	15.9	21.7	.5	10.0	7.4
Mechanical and industrial	87.3	70.2	70.8	5.9	6.7	7.6	6.1	12.4	14.3	.7	10.7	7.3
Mining and metallurgical	80.6	66.8	67.9	8.9	9.5	10.1	8.5	13.5	13.7	2.0	10.2	8.3

[1] Includes employees of private firms, independent consultants, "any other employment," and teaching.
[2] Includes employees of Federal, State, county, and municipal Governments, and other public authority.
[3] Includes direct relief and work relief.

Private engineering employment furnished by far the greatest amount of employment to engineers. In 1929, even among civil engineers, 54.3 percent were so employed. For the remaining 4 professional classes, the percentages ranged from 80.6 for mining and metallurgical to 87.3 for mechanical and industrial engineers. These proportions dropped sharply from 1929 to 1932 because of a decrease in the number of private jobs and an increase in the number of engineers. By December 1932, only 37.6 percent of the civil engineers reported as being in private engineering. The range for the remaining 4 professional classes was from 66.8 to 70.2 percent. By the end of 1934, there was a further decrease in the proportions privately employed among both civil and electrical engineers. The former decreased to 31.8 percent. Among electrical engineers, private engineering work had employed 67.8 percent in 1932 as compared with 63.1 percent in 1934. There was only a slight improvement over 1932 for the remaining professional classes.

In all classes, excepting chemical and ceramic engineers, the proportions engaged in public engineering increased from 1929 to 1934. The most pronounced shift occurred among the civil engineers, namely, from 40.0 percent in 1929 to 48.5 percent in 1934. This, in some measure, compensated for the large decline in the private engineering employment of this professional class. Indeed, as a result of public employment, the proportion of civil engineers in total engineering employment in both 1932 and 1934 was slightly higher than in any other professional class.

Lack of engineering employment opportunities in the period 1929–32 led to increases in both nonengineering employment and unemploy-

ment for all professional classes. In general, the loss of private employment occurred from 1929 to 1932. Nonengineering employment increased sharply, absorbing many more engineers than public engineering work, in which employment also increased. But despite the fact that the proportion of all engineers in nonengineering rose from 6.3 percent in 1929 to 12.0 percent in 1932, there was an even larger increase in unemployment. This situation was common to all professional classes.

There were further increases in the proportions engaged in nonengineering work among all professional classes in the period 1932–34. Among electrical engineers, the rate of increase in the proportion who were in nonengineering employment was three-fourths of that which occurred in 1929–32. But for the remaining professional classes the corresponding rates of increase were only one-third or less. In the case of civil engineers and mining and metallurgical engineers, there were almost no increases in the proportions engaged in nonengineering employment. For each of these groups there was a greater increase from 1932 to 1934 in public than in nonengineering employment. For civil engineers it was much larger. For mechanical engineers the proportions in public engineering rose from 6.7 percent in 1932 to 7.6 percent in 1934, whereas nonengineering embraced 12.4 percent of all mechanical engineers in 1932 and 14.3 percent in 1934. In their case, therefore, the rate of expansion in public engineering employment was less than that which occurred in nonengineering employment.

Employment Status of Two Groups of Younger Engineers

Comparison of the distributions of employment status in 1929 of those reporting engineers who entered the profession in the period 1925–29, with that in 1934 of a comparable group who entered the profession between 1930 and 1934, reflects the pressures to which new entrants were subjected during the depression years. It also emphasizes the abnormality of the employment status of the latter in 1934.

In 1929 only 5.3 percent of the most recent graduates with professional training were in nonengineering work and 0.4 percent were unemployed. In other words, all but one-twentieth of those who entered the profession in these 5 years were employed in engineering work in 1929. (Table 15.) But in 1934, two-fifths of the comparable group of recent engineering graduates [3] were not in regular professional engineering work. No less than 10.6 percent of them were unemployed in December 1934, while 29.4 percent reported as being engaged in nonengineering work.

[3] The term "engineering graduate" is used interchangeably with "entered the profession." The tabulations cover predominantly those who received first degrees in engineering in the years specified, but also include all "other" engineers (such as those whose college work was incomplete) who were 23 to 27 years old at the date of reported employment.

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TABLE 15.—*Comparative employment status of 2 groups of younger engineers*

Age group	Total	In private [1] engineering employment	In public engineering employment			In nonengineering employment	Unemployed [2]
			Federal	State and county	Municipal and other public authority		
	Number of engineers						
1925–29 engineers, who were 23 to 27 years of age in 1929	[3] 6,997	5,151	452	618	375	371	30
1930–34 engineers, who were 23 to 27 years of age in 1934	[3] 16,872	6,910	1,544	1,272	401	4,959	1,786
	Percentage						
1925–29 engineers, who were 23 to 27 years of age in 1929	100.0	73.6	6.5	8.8	5.4	5.3	0.4
1930–34 engineers, who were 23 to 27 years of age in 1934	100.0	40.9	9.2	7.5	2.4	29.4	10.6

[1] Includes employees of private firms, independent consultants, "any other employment," and teaching.
[2] Includes direct relief and work relief.
[3] The absolute numbers are not comparable. About twice as high a proportion of the younger groups returned schedules.

Of all recent engineers reporting both in 1929 and in 1934, approximately one-fifth were engaged in the three categories of public engineering. Insofar as any differences existed, there appears to have been a slight decline in the proportions of the 1930–34 group that secured public employment. The decrease in the percentage in State and county employment was only from 8.8 to 7.5. But municipal and other public authorities in 1929 had employed 5.4 percent of the 1925–29 engineers, whereas in 1934 they employed only 2.4 percent of those who entered the profession in the period 1930–34. On the other hand, the Federal Government employed a larger percentage of the recent graduates in 1934 than it had employed in 1929. For 1929, 6.5 percent of the 1925–29 engineers reported themselves as having been employed by the Federal Government, whereas 9.2 percent of the recent entrants to the profession were so employed in 1934.

In 1929 nearly three-fourths of the recent engineers were in private engineering employment. Only 40.9 percent of the 1930–34 engineers so reported for December 1934. Clearly, the abnormally large proportion of the new entrants to the profession who were unemployed or were compelled to find work of a nonengineering nature in 1934 was due primarily to the lack of opportunities in the principal field of engineering activity.

Employment Status of Older and Younger Engineers

This dependence upon private engineering employment is common to the greater part of the engineering profession. A substantial number, however, are normally in the employ of public authorities.

This is borne out by considering the distributions of employment status of all engineers reporting. These data are shown in table 16, divided into three broad classes, by age.[4]

TABLE 16.—*Distribution of older and younger engineers reporting, by employment status at end of 1929, 1932, and 1934*

Employment status	Number						Percentage					
	Older engineers [1]			Younger engineers			Older engineers [1]			Younger engineers		
				1930–32 [2]		1933–34 [3]				1930–32 [2]		1933–34 [3]
	1929	1932	1934	1932	1934	1934	1929	1932	1934	1932	1934	1934
Total	31,252	31,252	31,252	9,469	9,469	7,403	100.0	100.0	100.0	100.0	100.0	100.0
Engineering employment	29,051	25,327	25,548	5,248	6,057	4,070	93.0	81.1	81.8	55.4	64.0	55.0
Private employment	22,456	18,142	17,378	3,532	3,926	2,984	71.9	58.1	55.7	37.3	41.5	40.4
Private firm	19,424	14,894	14,422	3,247	3,748	2,892	62.2	47.7	46.2	34.3	39.6	39.2
Independent consultant	1,303	1,459	1,243	50	25	17	4.2	4.7	4.0	.5	.3	.2
Teaching	1,729	1,789	1,713	235	153	75	5.5	5.7	5.5	2.5	1.6	1.0
Public employment	6,595	7,185	8,170	1,716	2,131	1,086	21.1	23.0	26.1	18.1	22.5	14.6
Federal	1,647	2,063	3,149	531	1,008	536	5.3	6.6	10.1	5.6	10.6	7.2
State and county	2,632	2,884	2,882	927	872	400	8.4	9.2	9.2	9.8	9.2	5.4
Municipal and other public authority	2,316	2,238	2,139	258	251	150	7.4	7.2	6.8	2.7	2.7	2.0
Nonengineering employment	1,969	3,047	3,202	2,651	2,655	2,304	6.3	9.7	10.2	28.0	28.0	31.1
Unemployment	232	2,878	2,502	1,570	757	1,029	.7	9.2	8.0	16.6	8.0	13.9

[1] Includes both graduates and "other" engineers who reported they were professionally active prior to 1930.
[2] Includes both graduates and "other" engineers who entered the profession in the years 1930–32.
[3] Includes both graduates and "other" engineers who entered the profession in the years 1933 and 1934.

Of all older engineers reporting for December 1929, it will be noted that 71.9 percent were engaged in private engineering, 21.1 percent in public engineering, 6.3 percent in nonengineering work, and only 0.7 percent were unemployed. Of the 71.9 percent in private engineering, 62.2 percent were in the employ of private firms, 4.2 percent in independent consulting work, and 5.5 percent in teaching. In public engineering, the percentages for Federal, State and county, and municipal and other public authorities ranged from 5.3 to 7.4. This situation had an important bearing on the changes which occurred in the subsequent period, especially with regard to substitute employment.

Over the 5-year period there was a net change in the distributions of employment affecting 16.8 percent of the "older" engineers; that

[4] Table 16 presents the absolute figures for all reports received without adjustment. It deals with the older and younger engineers separately and, therefore, no adjustment was required in these broad age classifications, though allowance did have to be made for the relatively large number of reports received from young engineers when the groups were treated in combination.

Older engineers comprise those who reported they were active in professional engineering prior to 1930. The younger engineers are those who entered the profession in the years 1930–34, inclusive, and are divided into 2 broad-age groups, each designated by the graduating classes which they embrace, namely, 1930–32 engineers and 1933–34 engineers. Furthermore, in tabulating the data on employment status, homogeneity of the older and 1930–32 engineers was maintained. That is, in the case of the former, only those reporting for the 3 years 1929, 1932, and 1934 were used; in the case of the latter, only those reporting for the 2 years 1932 and 1934 were included. Analysis shows that the percentage eliminated was small.

is, of engineers who had entered the profession prior to 1930. In other words, out of every 1,000 engineers reporting, there were net changes in the employment status of 168 between 1929 and 1934. In absolute numbers, there were shrinkages of 5,255 jobs for engineers graduating prior to 1929. No less than 5,002 were separated from private firms. The remaining net losses of employment were distributed among those engaged in independent consulting (60), in teaching (16), and in municipal and other public employment (177). These decreases in employment opportunities for older engineers were not counterbalanced by increases in the other classes of engineering employment. In fact, 2,270 engineers reporting graduation prior to 1930 were still unemployed in December 1934, while 1,233 found employment in nonengineering work. Only 1,752 had been absorbed by increases in public engineering employment, one-sixth with State and county authorities, and five-sixths, or 1,502, with the Federal Government.

The major part of the loss of employment for older engineers occurred from 1929 to 1932. In this period net shifts in employment had affected the status of 14.7 percent of these men. The net change in the period 1932–34 involved only 4.0 percent of them. Obviously, by December 1932 the engineering profession had suffered the major impact of the depression. Between December 1929 and December 1932 there were net losses of employment involving 4,608 engineers. Only two of the categories of employment were involved, namely, that with private firms, and that with municipal and other public authorities. But of the 4,608 positions concerned, the shrinkage of employment with private firms affected 4,530; the latter, only 78. Of these engineers, only 884 were able to find other types of engineering employment by December 1932; nearly 50 percent of them entered Federal Government employment, while a third entered State and county employment. There were 156 additional engineers reporting themselves as being independent consultants and 60 as engaged in teaching. Of the remaining 3,724 engineers, 2,646 were unemployed and 1,078 were engaged in work of a nonengineering nature.

The shifts noted in the period 1929–32 are, therefore, indicative of two trends affecting engineers who had been in the profession in 1929: (1) The pronounced increase in Federal employment and the decrease in private employment; and (2) the comparative stability of the remaining classes of engineering employment. These trends are further accentuated by a consideration of the shifts which occurred between December 1932 and December 1934.

In 1932–34, all categories of engineering work, with the exception of that with Federal Government, decreased as regards employment

of engineers who had been in the profession in 1929. Thus, an additional net total of 472 engineers graduating before 1930 were separated from private firms. The decreases in jobs in the remaining engineering classes ranged from 2 in the case of State and county employment to 216 for independent consultants. Incidentally, it will be noted that the proportion engaged in the latter class was only slightly less than the proportion so engaged in 1929. This would seem to indicate that the increase which had taken place from 1929 to 1932 was an artificial one, in which otherwise unemployed engineers set themselves up as consultants. Altogether, the decreases in engineering employment between 1932 and 1934 affected 865 older engineers. Despite these decreases in many types of job opportunity, there was also a decrease of 376 in the number of engineers reporting unemployment. Only 155 found opportunities in nonengineering employment. The Federal Government gave engineering employment to the remaining 1,086 (87.5 percent) of those whose status shifted from 1932 to 1934.

The net result of the changes in employment status among the older engineers was such that by December 1934 only 46.2 percent were in the employ of private firms, whereas 62.2 percent had been so engaged at the end of 1929. Federal employment provided for 10.1 percent in December 1934, as against only 5.3 percent in 1929. All other classes of engineering employment remained comparatively stable over the period 1930–34, especially if State, county, and municipal employment are considered together. In December 1934 there were 8.0 percent unemployed, but it is obvious that had not 10.2 percent of the older engineers found work of a nonengineering nature, the proportion unemployed would have been larger by that amount. It is also obvious that by December 1934 it was primarily the increased engineering employment by the Federal Government that ameliorated employment conditions for these older engineers.

The contrast between the job status of recent graduates in 1929 and 1934 has already been noted. But certain outstanding shifts from 1932 to 1934 may be noted among the engineers who entered the profession during the depression. In the first place employment opportunities increased from the end of 1932 to the end of 1934 among those who graduated in 1930–32. Slightly more than half of the 16.6 percent of this group who had been unemployed or on work relief in 1932 found employment by 1934. Furthermore, they had found nonrelief engineering employment. There was no change in the proportion engaged in nonengineering work. The gain was almost equally divided between private employment and public employment. Fewer engineers graduating in 1930–32 were teaching or engaged in what they called consulting work. The increase in

employment by private firms, however, absorbed 5.3 percent of all engineers in these classes. Similarly, there was a slight decline in the proportions employed by States and counties, but this was much more than offset by an expansion of Federal engineering employment that absorbed an additional 5.0 percent of the total number.

A comparison of the distributions of employment of 1933–34 graduates in 1934 may be made with employment in 1932 of those graduating in 1930–32 to show how conditions had changed as regards the most recent graduates. This comparison is not perfect because in the one case 3 graduating classes are considered and in the other only 2. From 1932 to 1934 there was almost no change in the proportions of the most recent graduates who found engineering employment. Unemployment was slightly lower, primarily because 3.1 percent more 1933–34 graduates were in nonengineering work in 1934 than had been true of 1930–32 graduates in 1932.

While recent graduates in 1934 had as much opportunity for engineering employment as a comparable group had had in 1932, this was because of an expansion in private employment and particularly employment with private firms. Of the 1933–34 graduates, 4.9 percent more were employed by private firms and 1.8 percent fewer were in teaching or acting as independent consultants than had been the case in 1932 among 1930–32 graduates.

The total opportunities for public employment were less in 1934 among the most recent graduates than had been true of a similar group in 1932. The Federal Government did employ 1.6 percent more of them in 1934, but this could not offset the decline of employment opportunities with State, county, and municipal authorities from 12.5 percent of the 1930–32 graduates in 1932 to 7.4 percent of the 1933–34 graduates in 1934.

Employment Opportunities for Older and Younger Engineers Contrasted

The preceding discussion has shown the barriers that the depression threw in the way of newcomers to the profession. It now remains to examine the effect that even the partial absorption of the newcomers had upon the employment opportunities of the older engineers.

This interrelationship is best studied in two different phases of the employment cycle: (1) During a period of an absolute contraction in job opportunities, and (2) during a period of expansion. These conditions are represented respectively by the two periods 1929–32 and 1932–34. In the first, it will be recalled that total engineering employment for the adjusted sample decreased from 29,051 to 27,787. In the second period, it grew to 30,299 by the end of 1934. The adjusted data are presented in table 17.

TABLE 17.—*Increase or decrease, 1929 to 1934, in employment of older engineers and younger engineers, by employment status*

[Figures adjusted as explained on p. 34]

Employment status	Total number reporting			Increase or decrease			
				1929 to 1932		1932 to 1934	
	1929	1932	1934	Older [1] engineers	New [2] entrants	Older [1] engineers	New [3] entrants
Total	27,988	28,694	32,735	−2,862	+3,568	+668	+3,373
Private firm	19,424	16,416	17,534	−4,530	+1,522	−472	+1,590
State, county, and municipal government and other public authority	4,948	5,677	5,804	+174	+555	−101	+228
Federal Government	1,647	2,312	3,872	+416	+249	+1,086	+474
Nonengineering	1,969	4,289	5,525	+1,078	+1,242	+155	+1,081

[1] Includes those engineers who reported they were professionally active prior to 1930.
[2] Includes those engineers who entered the profession in the years 1930–32.
[3] Includes those engineers who entered the profession in the years 1933 and 1934, and also those who came in during this period from classes of 1930–32.

By December 1932 employment with private firms had declined by 15.5 percent. The loss of employment by private firms among older engineers was even greater than this. In absolute numbers, 4,530 were put out of work. Despite the enormous drop, even at this period of the depression no less than 1,522 of those engineers who entered the profession in the period 1930–32 found opportunities for engineering employment with private companies. Thus, approximately two-thirds of the loss of employment among older engineers was due to a decrease in the amount of private employment available. One-third was due to the fact that older engineers were unable to secure, or unwilling to take, employment which newcomers to the profession secured.

By the end of the second period, private firm employment increased by 1,118, or 6.8 percent, over that reported for December 1932. Here again there was a repetition of the condition noted for the period 1929–32. Even in this period there was a reduction in employment with private companies, affecting 472 of the older engineers. In passing, it should be noted that this decrease did not affect those who entered the profession from 1925 to 1929, but was confined to those who graduated prior to 1925. Essentially, therefore, those who entered the profession in the years 1930–34 secured all the net new employment that developed with private firms and also continued to find some openings at the expense of older engineers. Over the entire 5-year period 1930–34, although 5,002 older engineers suffered loss of employment with private firms, no less than 3,112 of the new entrants found engineering work.

A considerable number of the younger engineers were able to enter engineering activity with private firms, apparently at the expense of the older engineers. This admission of younger engineers into private-firm employment was probably not the result of a direct displacement on a particular job of any one group of older by younger engineers. The explanation is to be found in the relative ease with which a younger engineer found a new job as compared with an older one who had lost a job. The older engineer inevitably had a greater concern with the suitability of the employment and remuneration offered than had the man without an established position. Furthermore, the enormous influx of new entrants to the profession caused keen competition for all kinds of engineering employment, which, under the then prevailing conditions, were very definitely not of the type to suit the older engineers and which further depressed salary rates for the more elementary types of work.[5]

The changes effected by the depression upon the engineers in the employ of State and county, and municipal and other public authorities, are in striking contrast to those which occurred among older engineers in private firms. Between 1929 and 1932 there was a 14.7 percent increase over the total of 4,948 who were engaged by State and county and municipal and other public authorities in 1929. The increase was shared by both the older engineers and new entrants. The number of the former increased by 174, the latter by 555. By December 1934 the total so employed had increased to 5,804. But in this second period only the new entrants increased—by 228—whereas the older engineers decreased by 101, a net change in favor of the younger engineers of 127. It will, however, be noted that 73 of the net number of older engineers who entered these fields of employment by December 1932 were retained.

Clearly, the older engineers in the employ of these particular public authorities held on tenaciously to their jobs during the depression. The most marked shift as regards this type of employment was the decrease in the proportion of younger engineers who found work with such authorities. The decrease in the number of older engineers so employed by December 1934 may not have been due wholly to the increase of new entrants. Many of the older engineers may have found this employment an easier passage to Federal employment, which, in the period 1932–34, required a large number of engineers as administrators and supervisors for the work-relief programs then

[5] In this regard, it may here be noted that for men with advancing years of experience engaged in engineering, the monthly earnings of engineers who were 23½ years in 1929 and 28½ years in 1934 actually increased, whereas for succeeding age groups the decline in earnings became progressively greater. For men of corresponding years of experience the greatest decline occurred for engineers who had only from 2 to 5 years' experience in engineering work, as against relatively equal declines for newcomers and men with more than 5 years' engineering experience.

under way. These positions may have been more in keeping with the older engineers' previous training and experience.

This last statement is substantiated by the changes which occurred in Federal employment. In both periods the absolute number of older engineers who found this kind of work was greater than that for the younger engineers. Thus, by the end of December 1932 Federal employment increased by 40.0 percent from 1,647 to 2,312. This increase covered 665 engineers, which comprised 62.5 percent older and only 37.5 percent younger engineers. In the second period, the total number in the employ of the Federal Government increased from 2,312 to 3,872, an increase over 1932 of 68.0 percent. The absolute increase was divided in the ratio of 70.0 percent of the older to 30.0 percent of the younger engineers. Over the 5-year period, the respective total absolute increases were 1,502 and 723. It will also be noted that, while in the period 1929–32 the rate of increase of older to younger engineers was two to one, it increased to two and one-half times for the older by the end of December 1934. From this marked preference for older engineers in Federal Government employment, it can only be assumed that the nature of the work did more closely meet their criteria for reemployment, at least for such opportunities as were available.

This contrast of employment opportunities for older and younger engineers indicates that, taking all factors into consideration, between 1930 and 1934 there was a substantial net loss of employment by the engineers active before 1930 and a considerable absorption in employment of newcomers to the profession. As indicated, some of this shift may have been due to direct displacement; some of it to the securing of newly created positions by the younger men. The exact proportions affected by these two tendencies cannot, of course, be determined from the reports furnished in this survey. But consideration of the data on a more detailed age basis does reveal the general incidence of this situation.

Employment Status of Professional Classes by Age Groups

This analysis of the employment status data reported by engineers of different ages is confined to two groupings of the nine professional classes. In this regard it is necessary to recall that in the discussion of employment status for all engineers combined (table 16) it was there noted that in 1929 engineering employment was reported by 29,051 older engineers. Of this number, 22,456, or 71.9 percent, were in private engineering and 6,595, or 21.1 percent, were in public engineering. Further analysis of these data shows that of the 22,456 engineers engaged in private engineering in 1929 only 7,477, or 33.3 percent, were civil, agricultural, and architectural engineers, whereas

this same professional class comprised 5,510, or 83.5 percent, of the 6,595 in the employ of all public authorities. This marked contrast in engineering activity warrants separate analysis of the employment status of civil engineers, more especially as they constitute about half of the entire reporting sample. On the other hand, the close similarity in engineering activity of the other four professional classes permits of presenting their data in combination in view of the fact that the numbers in the samples for mining and metallurgical, and for chemical engineers are too small to support as detailed an analysis as is possible for civil engineers.

These particular data by age are presented in table 18 and in graphic form in chart 4.

The engineers in each professional group are classified by age and employment status in each of the 3 years. Thus, there were 2,310 civil engineers who were 50 years old in 1932 and who were over 47 in 1929. The employment status of this group is traced from year to year. The 4,280 who were 41–50 years of age in 1932 are treated as a second group, those 31–40 in 1932 as a third, and finally those 26–30 in 1932 as the fourth age group of the reporting engineers who had been in the profession in 1929. The sample was increased by 1,544 [6] newcomers by 1932 and by a further 1,035 [6] by 1934.

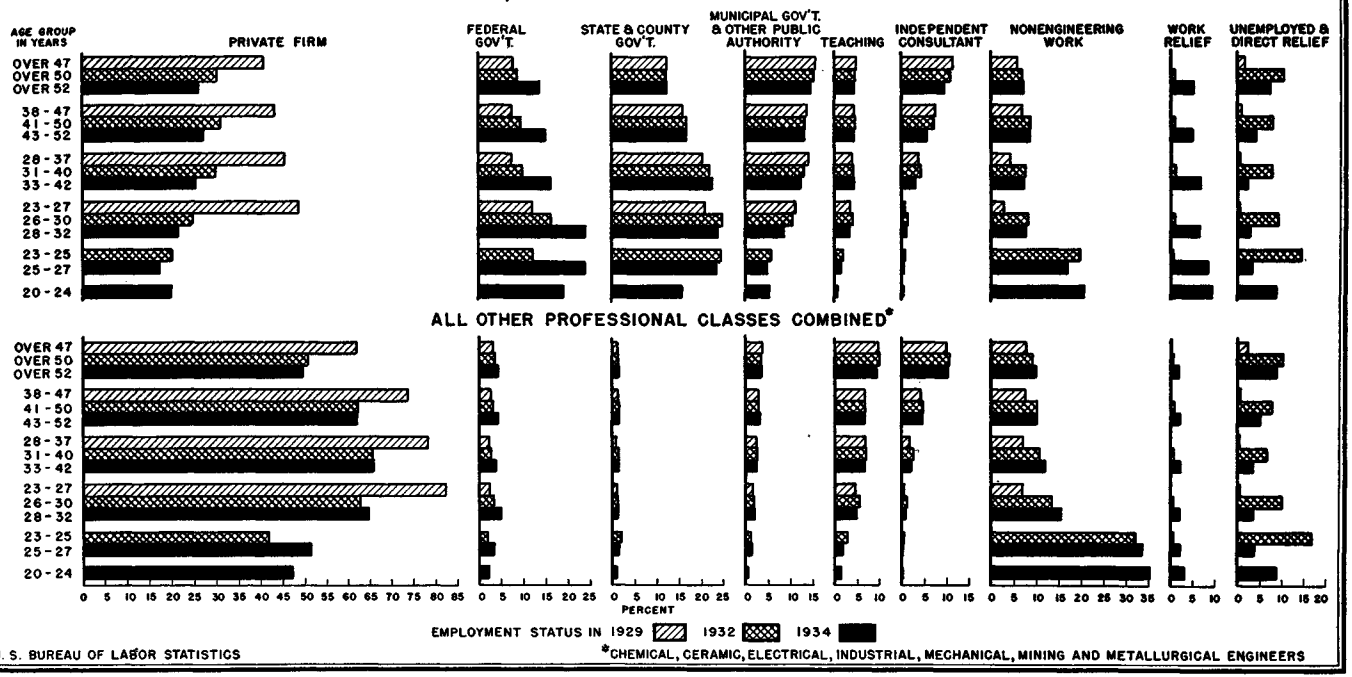
What happened to the distribution of jobs in civil engineering in connection with this addition of 2,579 engineers to the 13,786 already in the profession in 1929? In the first place, total private-firm employment for civil engineers declined from 6,181 in 1929 to 4,008 in 1934. But even with this limitation in opportunity, 483 newcomers to the profession found jobs with private firms in 1934. There was, therefore, a net displacement between 1929 and 1934 of 2,656 or 43 percent, of the civil engineers who had been with private firms in 1929. The displacement was greatest from 1929 to 1932 and for those civil engineers entering the profession from 1925–1929. Thus, of this group nearly half of those employed by a private firm in 1929 were not so employed in 1932. This proportion decreases in each higher age group. Among those over 50 the displacement amounted to about one-quarter.

For all those civil engineers who had been with private firms in 1929 there was a net loss by 1932 of 2,113 jobs, or 34 percent, while 312 newcomers to the civil engineering profession had jobs with private firms in 1932. From 1932 to 1934 there was a further net displacement of 543 of the older civil engineers, but in this period the loss of employment with private firms affected all age groups about equally, averaging nearly 13 percent of the 1932 employment.

[6] On an adjusted basis as explained on p. 34.

CHART 4.

DISTRIBUTION OF EMPLOYMENT STATUS OF PROFESSIONAL ENGINEERS BY AGE GROUP AT END OF 1929, 1932 & 1934



U. S. BUREAU OF LABOR STATISTICS

*CHEMICAL, CERAMIC, ELECTRICAL, INDUSTRIAL, MECHANICAL, MINING AND METALLURGICAL ENGINEERS

TABLE 18.—*Number of engineers reporting employment status at end of 1929, 1932, and 1934, by professional class and age*

[Without regard to type of education reported]

Employment status by professional class	Number																	
	Total [1]			Older [2] engineers												Younger [3] engineers		
	1929	1932	1934	Over 47 years in 1929	Over 50 years in 1932	Over 52 years in 1934	38–47 years in 1929	41–50 years in 1932	43–52 years in 1934	28–37 years in 1929	31–40 years in 1932	33–42 years in 1934	23–27 years in 1929	26–30 years in 1932	28–32 years in 1934	23–25 years in 1932	25–27 years in 1934	20–24 years in 1934
Civil, agricultural, and architectural	13,786	15,330	16,365	2,310	2,310	2,310	4,280	4,280	4,280	4,429	4,429	4,429	2,767	2,767	2,767	1,544	1,544	1,035
Private firm	6,181	4,380	4,008	944	701	608	1,858	1,339	1,177	2,023	1,335	1,138	1,356	693	602	312	273	210
Independent consultant	736	772	610	259	250	212	307	303	234	160	181	128	10	30	28	8	5	3
Teaching	560	608	573	109	105	100	186	187	180	173	179	180	92	107	92	30	17	4
Federal Government	1,177	1,693	2,936	180	200	319	319	406	649	338	445	727	340	454	674	188	369	198
State and county government	2,451	3,047	3,190	284	281	284	686	722	723	904	974	997	577	688	660	382	363	163
Municipal and other public authority	1,882	1,880	1,815	359	352	337	596	574	564	621	578	543	306	286	240	90	76	55
Nonengineering work	694	1,413	1,556	135	162	166	291	375	371	191	343	324	77	227	216	306	264	215
Work relief	2	127	1,016	-------	17	115	-------	33	208	1	43	291	1	26	177	8	127	98
Unemployed and direct relief	103	1,410	661	40	242	169	37	341	174	18	351	101	8	256	78	220	50	89
All other professional classes [4]	17,466	20,361	22,796	2,462	2,462	2,462	4,522	4,522	4,522	6,252	6,252	6,252	4,230	4,230	4,230	2,895	2,895	2,435
Private firm	13,243	12,039	13,539	1,524	1,253	1,226	3,337	2,810	2,812	4,898	4,107	4,114	3,484	2,656	2,745	1,213	1,492	1,150
Independent consultant	567	709	651	247	261	254	192	220	211	112	165	138	16	49	38	14	6	4
Teaching	1,169	1,289	1,238	241	245	234	308	307	306	427	435	417	193	224	204	78	50	27
Federal Government	470	614	940	81	92	113	125	139	199	152	181	252	112	146	216	56	106	54
State and county government	181	276	287	33	35	38	54	60	60	53	78	75	41	46	45	57	44	25
Municipal and other public authority	434	480	512	90	85	88	131	133	139	144	151	145	69	79	83	32	42	15
Nonengineering work	1,275	2,877	3,967	195	228	245	343	465	467	443	673	754	294	574	659	937	979	863
Work relief	4	136	508	-------	13	45	3	38	99	1	41	140	-------	27	84	17	62	78
Unemployed and direct relief	123	1,941	1,154	51	250	219	29	350	229	22	421	217	21	429	156	491	114	219

Percentage

Civil, agricultural, and architectural	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Private firm	44.9	28.6	24.6	41.0	30.4	26.3	43.4	31.2	27.4	45.8	30.2	25.6	48.9	25.0	21.8	20.3	17.4	20.1
Independent consultant	5.3	5.0	3.7	11.2	10.8	9.2	7.2	7.1	5.5	3.6	4.1	2.9	0.4	1.1	1.0	0.5	0.3	0.3
Teaching	4.1	4.0	3.5	4.7	4.5	4.3	4.3	4.4	4.2	3.9	4.0	4.1	3.3	3.9	3.3	1.9	1.3	0.7
Federal Government	8.5	11.0	17.9	7.8	8.7	13.8	7.5	9.5	15.2	7.6	10.0	16.4	12.3	16.4	24.3	12.5	24.0	19.2
State and county government	17.8	19.9	19.5	12.3	12.2	12.3	16.0	16.8	16.8	20.4	22.0	22.5	20.9	24.9	23.9	24.5	23.5	15.7
Municipal and other public authority	13.7	12.3	11.1	15.5	15.2	14.6	13.9	13.4	13.2	14.0	13.1	12.3	11.1	10.3	8.7	5.8	4.9	5.3
Nonengineering work	5.0	9.2	9.5	5.8	7.0	7.2	6.8	8.8	8.7	4.3	7.7	7.3	2.8	8.2	7.8	19.8	17.1	20.7
Work relief	(5)	.8	6.2	------	0.7	5.0	------	0.8	4.9	(5)	1.0	6.6	(5)	0.9	6.4	0.5	8.3	9.4
Unemployed and direct relief	.7	9.2	4.0	1.7	10.5	7.3	0.9	8.0	4.1	0.4	7.9	2.3	0.3	9.3	2.8	14.2	3.2	8.6
All other professional classes [4]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Private firm	75.9	59.1	59.4	61.9	50.8	49.8	73.8	62.2	62.1	78.4	65.7	65.8	82.3	62.8	64.8	41.8	51.4	47.2
Independent consultant	3.2	3.5	2.9	10.0	10.6	10.3	4.2	4.9	4.7	1.8	2.6	2.2	0.4	1.2	0.9	0.5	0.2	0.2
Teaching	6.7	6.3	5.4	9.8	10.0	9.5	6.8	6.8	6.8	6.8	7.0	6.7	4.6	5.3	4.8	2.8	1.8	1.2
Federal Government	2.7	3.0	4.1	3.3	3.7	4.6	2.8	3.1	4.4	2.4	2.9	4.0	2.6	3.5	5.1	1.9	3.6	2.2
State and county government	1.0	1.4	1.3	1.3	1.4	1.5	1.2	1.3	1.3	0.8	1.2	1.2	1.0	1.1	1.1	2.0	1.6	1.0
Municipal and other public authority	2.5	2.4	2.2	3.7	3.5	3.6	2.9	2.9	3.1	2.3	2.4	2.3	1.6	1.9	2.0	1.1	1.4	0.6
Nonengineering work	7.3	14.1	17.4	7.9	9.3	10.0	7.6	10.3	10.3	7.1	10.8	12.1	7.0	13.6	15.6	32.4	33.9	35.5
Work relief	(5)	.7	2.2	------	0.5	1.8	0.1	0.8	2.2	(5)	0.7	2.2	------	0.6	2.0	0.6	2.2	3.2
Unemployed and direct relief	.7	9.5	5.1	2.1	10.2	8.9	0.6	7.7	5.1	0.4	6.7	3.5	0.5	10.1	3.7	16.9	3.9	8.9

[1] Figures for 1932 and 1934 have been adjusted as explained on p. 34.
[2] Includes graduates and "other" engineers who reported they were professionally active prior to 1930.
[3] Includes graduates and "other" engineers who entered the profession in the periods 1930–32 and 1933–34.
[4] Includes chemical, ceramic, electrical, mechanical, industrial, mining, and metallurgical engineers.
[5] Less than 0.05 percent.

In the remaining professional groups in combination this situation differs chiefly in the fact that, although employment reported with private firms also declined from 13,243 in 1929 to 12,039 in 1932, it rose sharply to 13,539 in 1934. Between 1929 and 1932, 1,213 new engineers were added and, therefore, a net of 2,417 older engineers were displaced. It is impossible to determine the extent to which this represented a loss of jobs by the older groups and the filling of other new jobs that developed with younger men. Between 1929 and 1932, 25 percent of those who entered the profession from 1925–29 were displaced from private firms, whereas this proportion dropped to 12 percent among those 41 to 50. This resembles the experience of civil engineers, among whom also the senior group had the least insecurity. But the proportion rises again to 17 percent among those over 50.

From 1932 to 1934 there was a general expansion of private-firm employment among these professional groups. Recruiting was almost without exception from among engineers under 30 years of age. There was an actual net loss of 27 more jobs among those who were over 50 years of age in 1932 and a net gain of only 7 among the group 31–40 years of age in 1932. The group that were 26–30 years of age in 1932 were reemployed to the extent of 89 jobs; about one-tenth as many as they lost from 1929 to 1932. On the other hand, 279 more engineers were hired who had graduated in 1930–32 and 1,150 who graduated in 1933–34. Put slightly differently, there was no net increase in employment opportunity with private firms for men over 30. Men graduating in 1933–34 had an even chance of finding employment with a private firm by the end of 1934. Men who had been employed as junior engineers in 1929 but had lost their jobs had only one chance in 10.

Except for Federal Government employment, the men displaced from private firms found limited opportunities in the other four kinds of engineering employment shown in table 18. For example, engineers of all ages classified as independent consultants showed small changes in their numbers in the 3 years for which data were reported. In the case of all civil engineers reporting, the adjusted figures are 736 in 1929, 772 in 1932, and 610 in 1934. For all other professional classes, the corresponding figures are 567, 709, and 651. A similar situation is to be noted for men engaged in the teaching of engineering subjects and those in the employ of municipal and other public authorities. State and county governments, however, did offer a larger number of opportunities for engineering work, in that, for both groups of engineers the numbers so reporting steadily increased over the period 1929–34. The civil engineers, however, were the chief beneficiaries of this gain, for their numbers increased from 2,451 in 1929 to 3,047 in 1932 and to 3,190 in 1934, as against corresponding figures of 181, 276, and 287 for the other professional classes combined.

As regards Federal Government employment, all age groups participated in the increase of jobs. In the case of civil engineers some 1,177 were so engaged in 1929, but by 1932 the number had increased by 516 to 1,693. By 1934, 2,936 were in the employ of the Federal Government, an increase of 1,243 engineers even over that reported for 1932. By contrast, among the other professional classes, the increase in absolute numbers of men with the Federal Government was only from 470 in 1929 to 940 in 1934, that is, a change of only 470, or but one-quarter of the increase in the number of civil engineers for the same period.

Since employment opportunities in engineering were practically nonexistent in the period 1930–34, except for jobs obtained with the Federal Government, engineers displaced from private firms were left with the possibilities of going into nonengineering work, on work relief, or remaining unemployed. As regards nonengineering work, the data in table 18 clearly demonstrate that engineers of all ages were compelled to seek work of a nonengineering nature. Relatively, however, this situation was more acute for the two groups of younger engineers who entered the profession in the period 1930–34. On the other hand, as between civil engineers and the other professional classes combined, the data also show that, relatively, this shift into nonengineering work was smaller for the civil engineers, of whom 694 so reported in 1929 and 1,556 in 1934, an increase of 868 as against an increase of 2,692 over the same period among the other professional classes. Even in 1929 a smaller proportion (5.0 percent) of the civil engineers were engaged in nonengineering than was true of the other professional groups (7.3 percent). Relatively, at all ages this relationship held in 1934 but the span increased, especially in the case of those who graduated in the period 1925–29 and were 28 to 32 years of age in 1934, for in 1934, while 7.8 percent of civil engineers of these ages reported nonengineering work, the proportion was as high as 15.6 among the other professional classes. Similarly, in the case of the two groups of younger engineers there was a wide variation as between civil engineers and members of the other professional classes engaged in nonengineering work.

As regards work relief and unemployment, these data for the three stated periods are shown merely to indicate the over-all situation in regard to employment status. A detailed discussion of unemployment is to be found in chapter 6.

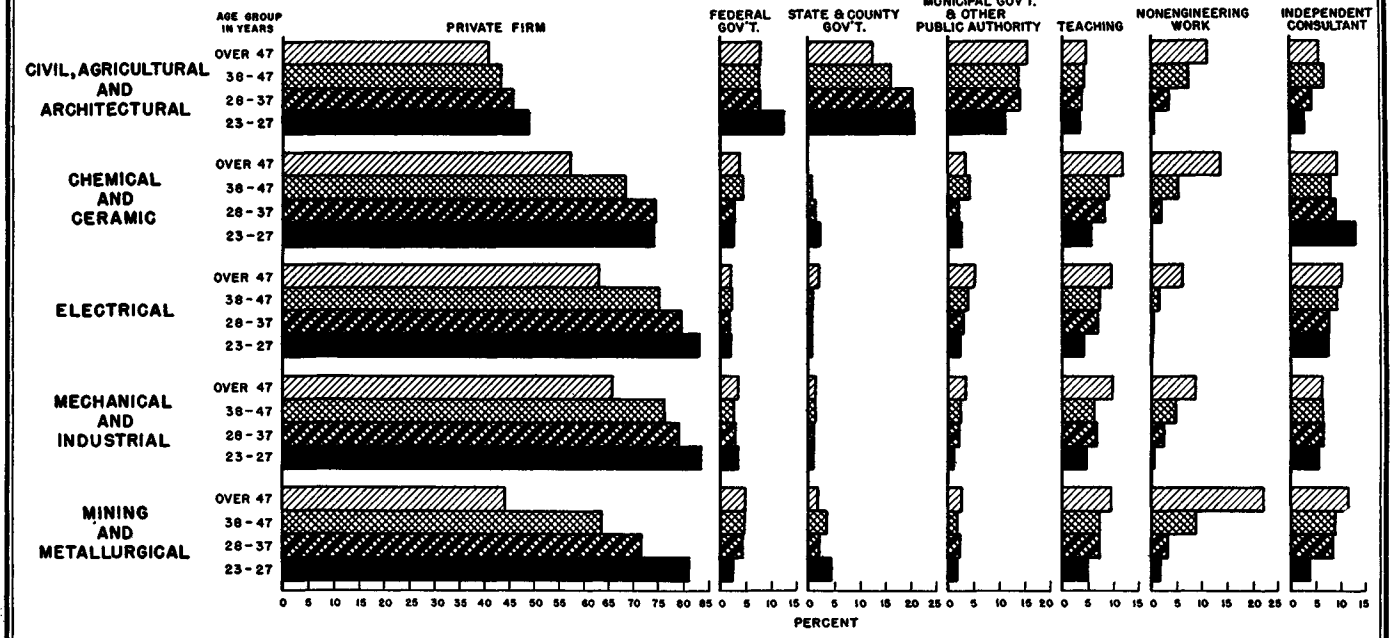
Employment in Relation to Engineering Experience

The preceding discussion has traced the apparent relationship between age and changes in employment status from 1929 to 1934. The shifts are obviously for the most part a reflection of the impact of the depression. But it must also be noted that certain kinds of shifts are

CHART 5.

DISTRIBUTION OF KINDS OF ENGINEERING EMPLOYMENT OF OLDER ENGINEERS AT END OF 1929

BY PROFESSIONAL CLASS



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ALL ENGINEERS ENGAGED IN ENGINEERING WORK PRIOR TO 1930

to be expected in any event, if the status of individual engineers is compared at the beginning and end of a 5-year period. The distribution of employment status in 1929 of the four age groups of engineers who reported that they were professionally active prior to 1930 seems to indicate that there are certain types of employment into which younger engineers flow and from which they move, with increasing experience, into other fields. (Table 19 and chart 5.)

As of December 1929 the majority of the new additions to each professional class found their first jobs with private firms. Despite the exodus into other fields which occurred with advancing age and experience, the proportions so employed remained substantially large. Even among engineers over 47 years these proportions ranged from 41.0 percent of the civil to 65.7 percent of the mechanical and industrial engineers. It will also be noted that the rates of decrease with age in the proportions employed by private firms among chemical and ceramic, electrical, and mechanical and industrial engineers closely paralleled each other. Mining and metallurgical engineers, however, show a more rapid decline even at low ages and a drop from 63.5 percent for those 38–47 years to 44.2 percent for engineers over 47 years of age. Over the four age groups the percentages for civil engineers declined gradually from 48.9 to 41.0.

In the case of civil engineers, the three categories of public engineering employment follow in importance after private-firm employment. The most important in 1929 was that of State and county government. As a training ground its usefulness extended through to the age of 37. During this time, slightly more than 20.0 percent of the civil engineers were so engaged. Between 37 and 47 years the proportion declined to 16.0. There was a further decline to 12.3 percent for civil engineers over 47 years of age. Next in order came Federal Government. In 1929 this gave employment to 12.3 percent of civil engineers 23–27 years. Thereafter it was primarily a field of final employment, as indicated by the fact that the proportions so employed remained fairly constant after 27 years of age, ranging from 7.5 to 7.8 percent. Municipal and other public authority employment constituted both a training ground and a field of final employment for civil engineers. Between 28 and 37 years a substantial number transferred from other fields of activity. This proportion remained fairly constant up to 47 years of age. Beyond this there was a sharp rise to 15.5 percent.

Teaching was not an important field of training for civil engineers. Thus, the proportions in this category of employment increased very gradually from 3.3 to 4.7 percent. Throughout, the proportions reported in each age group were relatively less than those reported for any other professional class. In the case of nonengineering em-

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TABLE 19.—*Distribution of all older [1] engineers reporting employment status at end of 1929, by professional class and age*

[Without regard to type of education reported]

Employment status	Civil, agricultural, and architectural				Chemical and ceramic				Electrical				Mechanical and industrial				Mining and metallurgical			
	23–27	28–37	38–47	Over 47	23–27	28–37	38–47	Over 47	23–27	28–37	38–47	Over 47	23–27	28–37	38–47	Over 47	23–27	28–37	38–47	Over 47
	Number of engineers in each specified age group in 1929																			
Total	2,767	4,429	4,280	2,310	374	576	367	153	1,810	2,265	1,447	590	1,861	2,961	2,218	1,415	185	450	490	304
Private firm [2]	1,356	2,023	1,858	944	278	430	251	88	1,506	1,805	1,088	372	1,550	2,340	1,687	930	150	323	311	134
Independent consultant	10	160	307	259	------	11	19	21	4	13	22	36	9	74	108	123	3	14	43	67
Teaching	92	173	186	109	21	47	33	18	76	157	103	56	87	191	137	138	9	32	35	29
Federal Government	340	338	319	180	9	15	16	6	36	38	30	11	63	79	56	49	4	20	23	15
State and county government	577	904	686	284	8	7	2	------	10	14	11	12	15	24	25	16	8	8	16	5
Municipal government and other public authority	306	621	596	359	9	11	15	5	38	64	56	30	19	59	52	47	3	10	8	8
Nonengineering work	77	191	291	135	48	52	29	14	133	167	133	60	106	187	138	86	7	37	43	35
Unemployment [3]	9	19	37	40	1	3	2	1	7	7	4	13	12	7	15	26	1	6	11	11
	Percentage of engineers in each specified age group in 1929																			
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Private firm [2]	48.9	45.8	43.4	41.0	74.4	74.7	68.4	57.4	83.2	79.7	75.1	63.0	83.3	79.0	76.2	65.7	81.1	71.8	63.5	44.2
Independent consultant	.4	3.6	7.2	11.2	------	1.9	5.2	13.7	.2	.6	1.5	6.1	.5	2.5	4.9	8.7	1.6	3.1	8.8	22.1
Teaching	3.3	3.9	4.3	4.7	5.6	8.2	9.0	11.8	4.2	6.9	7.1	9.5	4.7	6.5	6.2	9.8	4.9	7.1	7.1	9.5
Federal Government	12.3	7.6	7.5	7.8	2.4	2.6	4.4	3.9	2.0	1.7	2.1	1.9	3.4	2.7	2.5	3.5	2.2	4.4	4.7	4.9
State and county government	20.9	20.4	16.0	12.3	2.1	1.2	.5	------	.6	.6	.8	2.0	.8	.8	1.1	1.1	4.3	1.8	3.3	1.6
Municipal government and other public authority	11.1	14.0	13.9	15.5	2.4	1.9	4.1	3.3	2.1	2.8	3.9	5.1	1.0	2.0	2.3	3.3	1.6	2.2	1.6	2.6
Nonengineering work	2.8	4.3	6.8	5.8	12.8	9.0	7.9	9.2	7.3	7.4	9.2	10.2	5.7	6.3	6.2	6.1	3.8	8.2	8.8	11.5
Unemployment [3]	.3	.4	.9	1.7	.3	.5	.5	.7	.4	.3	.3	2.2	.6	.2	.6	1.8	.5	1.3	2.2	3.6

[1] Includes both graduates and "other" engineers who reported they were professionally active prior to 1930.
[2] Includes employees of private consulting firms and in "any other employment."
[3] Includes direct relief and work relief.

ployment, the progressive increase with age was much sharper than that indicated for teaching. After the age of 47, however, the proportions declined from 6.8 to 5.8 percent. Independent consulting did not attain importance for civil engineers until between 28 and 37 years of age. Over the four age groups this category of employment showed the sharpest increase with age. The most marked change occurred after 47 years, at which time the proportions engaged in independent consulting rose from 7.2 to 11.2 percent.

Among chemical and ceramic, electrical, mechanical and industrial, and mining and metallurgical engineers, the two most important sources of employment for recent graduates, after private-firm employment, were teaching and nonengineering. Throughout all four age groups the proportions reported in these two fields were relatively very much higher than they were for the corresponding age groups in any one of the three categories of public engineering. This was also the case with regard to independent consulting, but only up to the age of 47. By comparison with nonengineering employment, the most marked uniformity of trend with age obtained in teaching. Thus, for the latter, after the age of 27, the relative increases were practically the same for all four professional classes. These proportions remained fairly constant up to the age of 47. Beyond this age limit, there were sharp rises. It will also be noted, that, in the case of chemical and ceramic engineers, teaching embraced a higher proportion in each age group than any other professional class. (The proportions of the latter were consistently the same throughout.) Thus, over the four age groups, the percentages of chemical and ceramic engineers so engaged ranged from 5.6 to 11.8. The corresponding percentages reported by electrical, mechanical and industrial, and mining and metallurgical engineers averaged from 4.6 to 9.6 percent.

In nonengineering employment, slightly higher proportions were reported by electrical and mining and metallurgical engineers. The progressive increases with age were also more sharply defined for the latter. In the case of electrical engineers, the proportions increased gradually from 7.3 percent of the youngest to 10.2 percent of the oldest of the four age groups. By contrast, mining and metallurgical engineers increased sharply after 27 years of age from 3.8 to 8.2 percent. There was a further increase to 8.8 percent for engineers 38 to 47 years; after which there was another sharp rise to 11.5 percent of engineers over 47 years. For mechanical and industrial engineers, the percentages reported for nonengineering employment remained fairly constant. Of the oldest chemical and ceramic engineers, 9.2 percent were engaged in nonengineering work.

As in the case of civil engineers, members of the other four professional classes showed the same trends with age in the three categories of public engineering employment. That is to say, they con-

stituted both a training ground and a field of final employment. The only progressive increases with age occurred in Federal Government employment for mining and metallurgical engineers; and in positions with municipal and other public authorities for electrical and mechanical and industrial engineers. The remaining proportions reported for public engineering followed the same general tendency—they decreased after 27 years of age and increased between the ages of 38 and 47. In most instances, there were further increases reported for engineers over 47 years.

Independent consulting was, of course, practically nonexistent as a type of employment for the recent graduate. It was, however, the one field in which the respective proportions were sharply defined. By the age of 37, relatively a larger number of mechanical and industrial, and mining and metallurgical engineers were established as independent consultants than was the case for chemical and ceramic and electrical engineers. The latter reported only 0.6 percent. The highest percentage for this age group, namely 3.1, occurred among mining and metallurgical engineers, which class maintained this relative differential for the two remaining age groups, and between the ages of 38 and 47, covered 8.8 percent. By contrast, only 5.2 and 4.9 percent, respectively, of the chemical and ceramic and mechanical and industrial engineers were so engaged. Again electrical engineers were the lowest with 1.5 percent. The proportionate increases for all four professional classes were very marked indeed after the age of 47. This covered 22.1 percent of the mining and metallurgical and 13.7 percent of the chemical and ceramic engineers, whereas the proportions of electrical, and mechanical and industrial engineers over 47 years engaged in independent consulting were 6.1 and 8.7, respectively.

Employment in Relation to Type of Education

Elsewhere the statement has been made that there is quite an apparent tendency to increase the educational requirements for entry into the engineering profession. Broadly speaking, however, each of the six types of education for which data have been compiled will continue for some time as components of the engineering profession. Hence, an examination of the relation of each type of education to the seven categories of employment is warranted. Again only the data for those engineers who reported they were professionally active prior to 1930 are presented in table 20.

Irrespective of type of education, engineers are overwhelmingly dependent upon private industry for employment. Thus, among the graduates of both engineering colleges and noncollegiate technical schools, almost two-thirds were employed by private firms in 1929.

Approximately three-fifths of the engineers with a secondary school education or whose college course was incomplete were so employed. Only among postgraduates did private firms employ as little as one-half.

TABLE 20.—*Employment status at end of 1929 of all older [1] engineers reporting, by type of education*

Employment status	Type of education						
	All types of education	Graduate engineers			"Other" engineers		
		First-degree engineering graduates	Postgraduates	Nonengineering graduates	College course incomplete	Noncollegiate technical school	Secondary school
	Number						
Total	31,252	20,721	1,865	814	4,665	2,334	853
Private firm [2]	19,424	13,274	926	463	2,713	1,523	525
Independent consultant	1,303	816	45	48	247	101	46
Teaching	1,729	1,050	549	59	56	13	2
Federal Government	1,647	1,113	92	113	223	69	37
State and county government	2,632	1,514	80	44	613	265	116
Municipal government and other public authority	2,316	1,366	61	42	507	229	111
Nonengineering work	1,969	1,440	102	43	265	109	10
Unemployment [3]	232	148	10	2	41	25	6
	Percentage						
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Private firm [2]	62.2	64.0	49.7	56.9	58.1	65.2	61.6
Independent consultant	4.2	3.9	2.4	5.9	5.3	4.3	5.4
Teaching	5.5	5.1	29.4	7.2	1.2	.6	.2
Federal government	5.3	5.4	4.9	13.9	4.8	3.0	4.3
State and county government	8.4	7.3	4.3	5.4	13.1	11.3	13.6
Municipal government and other public authority	7.4	6.7	3.3	5.2	10.9	9.8	13.0
Nonengineering work	6.3	6.9	5.5	5.3	5.7	4.7	1.2
Unemployment [3]	.7	.7	.5	.2	.9	1.1	.7

[1] Includes both graduates and "other" engineers who reported they were professionally active prior to 1930.
[2] Includes employees of private consulting firms and "any other employment."
[3] Includes direct relief and work relief.

The second largest employment outlet was clearly defined only among postgraduates. No less than 29.4 percent reported as being engaged in teaching. Of the nonengineering graduates 13.9 percent were in the employ of the Federal Government. The proportions engaged in the remaining kinds of employment for these two types of education did not show a large variation. For first-degree engineering graduates, State and county government work followed in importance after private-firm employment. Only 7.3 percent were so employed, but it should be noted that this differed but slightly from 6.9 percent who were engaged in nonengineering work and 6.7 percent embraced by municipal and other public authorities.

After private-firm employment, all "other" engineers had, as close options for employment, the same two categories of public engineering.

For all three types of education, State and county government employment was only slightly more important than that with municipal and other public authorities. Furthermore, in both instances, the secondary-school engineers reported the higher proportions. Thus, while 13.6 percent of them were in the employ of State and county governments, those whose college course was incomplete and graduates of noncollegiate technical schools reported 13.1 and 11.3 percent, respectively. A similar order was noted for positions with municipal and other public authorities, in which the percentages ranged from 9.8 for noncollegiate technical school engineers to 13.0 percent for the secondary-school engineers.

Except for the 13.9 percent of nonengineering graduates who were in the employ of the Federal Government, there was no extreme variation among the remaining proportions reported by graduates and "other" engineers. The highest (5.4 percent) occurred for first-degree engineering graduates; the lowest (3.0 percent) for noncollegiate technical school engineers. This was also the case with regard to the percentages reported for independent consulting. A similar condition was noted in nonengineering employment for all types of education, except secondary school engineers. Only 1.2 percent of this number were engaged in nonengineering work.

The greatest divergence in the proportions reported by each type of education occurred in teaching. It has already been noted that 29.4 percent of the postgraduates were so engaged. But although the numbers in each of the other two types of graduate education were much lower, relatively they were much higher than those for the "other" engineers. Thus, while 5.1 percent of all first-degree engineering graduates found employment as teachers of engineering subjects, the highest percentage reported among "other" engineers was only 1.2. Clearly, the educational requirements for teaching of engineering are exceptionally high. This is further exemplified by a consideration of the relation of the proportions reported for each type of education in terms of the grand total engaged in each employment category.

Of the 1,729 engineers engaged in the teaching of engineering subjects, 60.7 percent were first-degree engineering graduates and 31.8 percent were postgraduates. Nonengineering graduates and college-incomplete engineers embraced nearly the same proportions, averaging but 3.3 percent of the whole. The next highest percentage of 0.8 referred to noncollegiate technical school engineers. Clearly, in relation to the whole, teaching does demand a higher standard of educational requirement. Furthermore, it is unquestionably one in which engineers with postgraduate training are in greatest demand.

A similar analysis of the remaining engineering employment classes also evidenced another slight differential in educational requirements. Thus, among the graduate engineers, and for private-firm and Fed-

eral Government employment, the several proportions were consistently higher than those for State and county, and municipal and other public authorities. Among the "other" engineers, this condition was reversed. Furthermore, the percentages reported by the "other" engineers for these particular employment classes showed a greater divergence than was the case for the graduate engineers. Thus, while college-incomplete engineers averaged 23.0 percent of all engineers employed by State and county, and municipal and other public authorities, those employed by private firms and the Federal Government only averaged 13.7 percent of the whole. The noncollegiate technical school engineers included only 4.2 percent of the total working for the Federal Government. For the other two employment categories of public engineering, they averaged 10.0 percent. Their private-firm employment embraced 7.8 percent. Relatively, the secondary school engineers showed the smallest differential. Thus, in positions with private firms and the Federal Government, they averaged 2.5 percent as against 4.6 percent of all engineers reported for State and county and municipal and other public authorities.

It was previously indicated that independent consulting was essentially a field of employment that became markedly important only after the age of 47. To a lesser extent, this was also noted for nonengineering employment and teaching. It has been demonstrated that teaching does demand a higher educational standard. By contrast, it is evident that experience is an important criterion for entry into independent consulting and nonengineering work; for both the two highest proportions covered first-degree engineering graduates and college-incomplete engineers. Those reported by the remaining types of education were very much less. In each instance, however, it was noted that noncollegiate technical school engineers followed after those whose college course was incomplete. These relative proportions were 19.0 and 7.8 percent for independent consulting and 13.5 and 5.5 percent in the case of nonengineering employment.

Fields of Engineering Activity [7]

Although the distributions by fields of engineering activity presented in table 21 merely reflect in more detailed form the activity peculiar to each professional class, they again show that for the majority of engineers the choice of employment in such activities is somewhat narrowly confined. In general, chemical and ceramic and mechanical and industrial engineers are dependent primarily upon manufacturing industries for their employment. To a lesser extent, so are mining and metallurgical and electrical engineers, while civil engineers predominate in the construction field of employment.

[7] Fields of engineering activity are synonymous with zones of interest in question 12 of the questionnaire.

Relatively, however, chemical and ceramic engineers are more dependent upon manufacturing industries for their employment than any of the other four professional classes, for of their older engineers no less than 66.6 percent were so engaged in December 1934. In the other fields of engineering activity, the proportions of chemical and ceramic engineers reporting were very small. Thus, for all three age groups the proportions employed by public utilities and extractive industries were practically the same and embraced, respectively, 4.5 percent and 5.7 percent of men professionally active prior to 1930. Transportation and construction work were practically nonexistent as fields of employment for chemical and ceramic engineers. In the combined fields of public employment, however, 8.5 percent of the older engineers reported as being engaged, while 11.6 of this same group were engaged in teaching and personal service.

In general, mechanical and industrial engineers closely paralleled the distributions noted for chemical and ceramic engineers. They followed second in order in regard to the proportions embraced in manufacturing with 53.8 percent of their older engineers so employed and in personal service 11.3 percent of this same group were so engaged. So also in the three categories of public employment there was a close similarity between chemical and ceramic and mechanical and industrial engineers. However, in the fields of engineering activity designated public utilities, extractive industries, transportation, and private construction, the proportions were much higher, averaging from 4.1 to slightly over 9 percent over the three age groups.

By contrast to the distributions just discussed, it is of interest to note that both mining and metallurgical engineers and electrical engineers had alternative fields of engineering activity to manufacturing, covering, respectively, extractive industries and public utilities. The figures show that, in the case of mining and metallurgical engineers, manufacturing and extractive industries together accounted for 86.6 percent of the younger engineers and as many as 72.2 percent of the men professionally active prior to 1930. The corresponding proportions for electrical engineers in manufacturing and public utilities were 74.4 percent and 72.7 percent. It is, however, to be noted that over the three age groups the proportions of each of these professional classes in manufacturing steadily declined, while those reported for both extractive industries and public utilities steadily increased. In general, these two professional classes show similar distributions in the remaining fields of engineering activity.

Civil, agricultural, and architectural engineers again present the same situation as was noted in the discussion of kinds of engineering employment, namely, that they predominate in the construction fields of private industry and public employment, while their opportunities in other fields of employment were very low. Thus, in

TABLE 21.—*Number of engineers reporting field of engineering activity at end of 1934, by professional class and age group*

Field of engineering activity	Chemical and ceramic			Mechanical and industrial			Mining and metallurgical			Electrical			Civil, agricultural, and architectural		
	Younger engineers born		Older engineers born prior to 1907 [3]	Younger engineers born		Older engineers born prior to 1907 [3]	Younger engineers born		Older engineers born prior to 1907 [3]	Younger engineers born		Older engineers born prior to 1907 [3]	Younger engineers born		Older engineers born prior to 1907 [3]
	1910–14 [1]	1907–9 [2]		1910–14 [1]	1907–9 [2]		1910–14 [1]	1907–9 [2]		1910–14 [1]	1907–9 [2]		1910–14 [1]	1907–9 [2]	
	Number														
All fields	627	658	1,279	1,310	1,556	7,061	172	209	1,146	755	1,177	4,949	1,328	2,131	11,532
Manufacturing	481	545	853	825	942	3,792	84	79	262	333	442	1,559	79	99	617
Public utilities	35	15	58	91	146	604	-------	8	12	228	458	2,033	30	60	441
Extractive industries	35	53	73	68	68	243	65	83	564	31	31	70	74	85	317
Transportation	5	2	15	75	64	328	-------	-------	4	23	28	164	21	40	495
Construction (private)	9	6	24	106	117	639	2	2	23	24	40	125	215	261	1,885
Federal Government [4]	23	10	42	56	89	412	11	11	79	43	63	204	415	711	2,523
State and county government [4]	9	7	23	19	41	110	4	11	39	23	30	83	388	678	3,011
Municipal government [4]	9	2	43	11	10	137	-------	1	22	9	26	204	65	114	1,448
Personal service [5]	21	18	148	59	79	796	6	14	141	41	59	507	41	83	795
	Percentage														
All fields	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Manufacturing	76.8	82.8	66.6	63.0	60.6	53.8	48.8	37.8	22.9	44.2	37.6	31.5	5.9	4.6	5.4
Public utilities	5.6	2.3	4.5	6.9	9.4	8.6	-------	3.8	1.0	30.2	38.9	41.2	2.3	2.8	3.8
Extractive industries	5.6	8.1	5.7	5.2	4.4	3.4	37.8	39.6	49.3	4.1	2.6	1.4	5.6	4.0	2.7
Transportation	.8	.3	1.2	5.7	4.1	4.6	-------	-------	.3	3.0	2.4	3.3	1.6	1.9	4.3
Construction (private)	1.4	.9	1.9	8.1	7.5	9.0	1.2	1.0	2.0	3.2	3.4	2.5	16.2	12.2	16.3
Federal Government [4]	3.7	1.5	3.3	4.3	5.7	5.8	6.4	5.3	6.9	5.7	5.4	4.1	31.2	33.5	21.9
State and county government [4]	1.4	1.1	1.8	1.5	2.6	1.6	2.3	5.3	3.4	3.0	2.5	1.7	29.2	31.8	26.1
Municipal government [4]	1.4	.3	3.4	.8	.6	1.9	-------	.5	1.9	1.2	2.2	4.1	4.9	5.3	12.6
Personal service [5]	3.3	2.7	11.6	4.5	5.1	11.3	3.5	6.7	12.3	5.4	5.0	10.2	3.1	3.9	6.9

[1] Includes graduates and "other" engineers who entered the profession in the period 1933–34.
[2] Includes graduates and "other" engineers who entered the profession in the period 1930–32.
[3] Includes graduates and "other" engineers who reported they were professionally active prior to 1930.
[4] Primarily engineers engaged on construction work.
[5] Includes engineers engaged in teaching, publications, professional, trade organizations, etc.

manufacturing, only 5.4 percent of their older engineers were so employed, in public utilities 3.8 percent, in extractive industries 2.7 percent, and in transportation 4.3 percent. The 6.9 percent reporting in personal service was relatively the lowest of the five professional classes.

Types of Engineering Work [8]

Consideration of the distributions of engineers by type of work (table 22) shows that operation was the most important one for the younger engineers in all five professional classes, except civil engineering. Thus, while 62.7 percent and 56.8 percent of the younger chemical and ceramic engineers reported operation as their type of work, only 35.5 percent of the older engineers in this professional class were so engaged. Similarly, declines are to be noted for mining and metallurgical, electrical, and mechanical and industrial engineers, although from 20.8 percent to 37.1 percent of the older engineers in these three classes were in operation. Among civil engineers operation as a type of work embraced only 18.7 percent and 14.2 percent of the younger engineers, and but 11.2 percent of those professionally active prior to 1930.

After operation, and except for civil engineers, the next highest proportions are to be noted for men engaged in design and research. The general tendency in this type of work was for the percentages to increase with age. This was especially so for chemical and ceramic engineers and electrical engineers, and to a lesser extent for mining and metallurgical engineers. For the other two professional classes the proportions remained fairly constant. Over the five groups of older engineers the range in the numbers in design and research was from 19.3 for mining and metallurgical engineers to 34.2 percent of the chemical and ceramic engineers.

As regards construction, it is to be noted that in this type of work civil engineers predominated. No less than 49.0 percent and 52.6 percent of the younger engineers and 43.7 percent of the older engineers of this professional class so reported. The lowest proportions in construction work covered chemical and ceramic engineers and averaged only 2.6 percent. Among the other three professional classes, from 7 percent to 10 percent of their members were engaged in construction.

The numbers reporting sales work seem to indicate that this type of work was relatively more important only to electrical and mechanical and industrial engineers. Thus, while the former averaged 4.0 percent of their younger engineers, the latter was slightly higher with nearly 6.0 percent. For the older engineers in these two professional classes

[8] Types of engineering work are synonymous with functional classification in question 13 of the questionnaire.

TABLE 22.—*Number of engineers reporting type of engineering work at end of Dec. 1934, by professional class and age group*

Type of engineering work	Chemical and ceramic			Mining and metallurgical			Electrical			Mechanical and industrial			Civil, agricultural, and architectural		
	Younger engineers born		Older engineers born prior to 1907 [3]	Younger engineers born		Older engineers born prior to 1907 [3]	Younger engineers born		Older engineers born prior to 1907 [3]	Younger engineers born		Older engineers born prior to 1907 [3]	Younger engineers born		O der engineers born prior to 1907 [3]
	1910–14 [1]	1907–9 [2]		1910–14 [1]	1907–9 [2]		1910–14 [1]	1907–9 [2]		1910–14 [1]	1907–9 [2]		1910–14 [1]	1907–9 [2]	
	Number														
All types	645	611	1,203	168	198	1,069	725	861	4,975	1,254	1,479	6,628	1,286	2,052	10,947
Operation	405	347	427	116	110	397	385	342	1,515	530	565	1,378	240	291	1,225
Design and research	192	195	412	29	44	206	158	291	1,378	405	500	2,128	320	491	2,301
Construction [4]	10	17	29	13	16	67	69	113	524	95	124	661	630	1,079	4,789
Sales	8	11	50	2	3	24	32	36	362	67	98	640	3	20	157
General administration and management	7	12	90	2	7	113	24	20	411	87	103	761	34	60	1,102
Consulting [5]	13	11	75	4	11	142	35	30	353	32	44	494	44	63	795
Teaching	10	18	120	2	7	120	22	29	432	38	45	566	15	48	578
	Percentage														
All types	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Operation	62.7	56.8	35.5	69.0	55.6	37.1	53.2	39.7	30.4	42.3	38.2	20.8	18.7	14.2	11.2
Design and research	29.8	31.9	34.2	17.3	22.2	19.3	21.8	33.8	27.7	32.3	33.8	32.0	24.9	23.9	21.0
Construction [4]	1.6	2.8	2.4	7.7	8.1	6.3	9.5	13.1	10.5	7.6	8.4	10.0	49.0	52.6	43.7
Sales	1.2	1.8	4.2	1.2	1.5	2.2	4.4	4.2	7.3	5.3	6.6	9.7	.2	1.0	1.4
General administration and management	1.1	2.0	7.5	1.2	3.5	10.6	3.3	2.3	8.3	6.9	7.0	11.5	2.6	2.9	10.1
Consulting [5]	2.0	1.8	6.2	2.4	5.6	13.3	4.8	3.5	7.1	2.6	3.0	7.5	3.4	3.1	7.3
Teaching	1.6	2.9	10.0	1.2	3.5	11.2	3.0	3.4	8.7	3.0	3.0	8.5	1.2	2.3	5.3

[1] Includes graduates and "other" engineers who entered the profession in the period 1933–34.
[2] Includes graduates and "other" engineers who entered the profession in the period 1930–32.
[3] Includes graduates and "other" engineers who reported they were professionally active prior to 1930.
[4] Includes both private and public construction.
[5] Includes both independent consultants and engineers employed as consultants with private firms.

the respective percentages were 7.3 and 9.7. By contrast, among the younger members of the other three professional classes, the percentage engaged in sales did not exceed 2 percent, and ranged from 1.4 to 4.2 percent of their older engineers.

As would be expected, general administration and management covered a higher proportion of younger mechanical and industrial engineers than that reported by any other professional class. The numbers so reporting embraced 7.0 percent, as against only 3.5 percent of the 1933–34 mining and metallurgical engineers. Among the older engineers reporting, however, there was little difference in the several proportions so engaged. For the case of older chemical and ceramic engineers some 7.5 percent were in general administration and management, while the highest percentage reported covered 11.5 percent of the mechanical and industrial engineers.

Consulting and teaching both present the same characteristics. First, they apparently do not offer a wide range of employment to younger engineers. Second, there was a close similarity in the proportions of older engineers engaged in these two types of work. Thus, while for consulting the proportions ranged from 6.2 to 13.3 percent, they ranged from 5.3 percent to 11.2 percent for teaching.

Chapter V

Conditions of Employment in the Engineering Profession

One of the effects of the depression years was to bring about a quickening of interest in the whole subject of economic security of professional groups, for, prior to the onset of the depression in 1929, such topics were primarily the concern of nonprofessional workers. Because of this a series of questions relating to economic security was incorporated in this survey of the engineering profession. In effect they supplement the preceding discussion of employment and the subsequent one on unemployment among professional engineers. The particular aspects covered are as follows: (1) Means used to obtain employment, (2) civil-service status, (3) the employment and separation contract, and (4) provision for retirement on pension. The data [1] were derived from reports furnished only by engineers who had engineering jobs in December 1934.

Means Used to Obtain Employment

The data furnished by engineers concerning the medium through which they obtained employment are presented in table 23.

These figures demonstrate that for the engineering profession as a whole, placement was not the function of any particular organization. The vast majority of professional engineers obtained their jobs through personal contacts and recommendations. This was the means used to find the position held in 1934 by no less than 68.4 percent of the 35,559 engineers who also reported the field of engineering activity in which they were engaged. This medium of finding employment was reported by three-quarters of the chemical, electrical, and mining and metallurgical engineers, and by slightly more than 70.0 percent

[1] The numbers reported in this chapter as engaged in engineering work in December 1934 cannot be compared with those shown in the discussion of employment. The former were derived from all of the 35,890 engineers who reported the field of engineering in which they were engaged. The discussion of employment dealt with all those older engineers who reported in the 3 years 1929, 1932, and 1934, and all 1930–32 engineers who reported in 1932 and 1934. The grand total, including the 1933–34 engineers, was 35,675.

Of the 35,890 engineers who gave income data in their special field, 331 did not report the year of their birth. Hence, 35,559 constitutes the base for all subsequent relationships with field of engineering activity engaged in. But 1,458 of these engineers did not report as to type of work engaged in, and hence 34,101 was used as a base figure for all subsequent relationships with type of engineering work.

Furthermore, the data shown in the tables of this chapter are unadjusted, as spot checks of the figures showed that the adjusted data did not differ sufficiently to affect the general discussion and conclusions derived therefrom.

TABLE 23.—*Distribution at end of 1934 of all engineers reporting medium of obtaining employment, by professional class*

Medium used to obtain employment	Engineers utilizing each specified medium					
	All professional classes	Chemical and ceramic engineers	Civil, agricultural, and architectural engineers	Electrical engineers	Mechanical and industrial engineers	Mining and metallurgical engineers
	Number					
All media	35,559	2,538	14,861	6,816	9,833	1,511
Personal contacts and recommendations	24,312	1,927	9,179	5,106	6,960	1,140
Civil service	3,706	63	2,941	289	343	70
Engineering society	841	36	274	130	360	41
Private employment agency	576	49	113	112	285	17
Newspapers	567	27	152	120	255	13
Technical journals	363	54	142	64	85	18
United States Employment or Reemployment Service	264	7	190	14	46	7
Other public employment service	268	15	169	26	54	4
Any other medium	2,551	259	706	655	849	82
Medium not reported	2,111	101	995	300	596	119
	Percentage					
All media	100.0	100.0	100.0	100.0	100.0	100.0
Personal contacts and recommendations	68.4	75.9	61.7	75.0	70.7	75.4
Civil service	10.4	2.5	19.8	4.2	3.5	4.6
Engineering society	2.4	1.4	1.8	1.9	3.7	2.7
Private employment agency	1.6	1.9	.8	1.6	2.9	1.1
Newspapers	1.6	1.1	1.0	1.8	2.6	.9
Technical journals	1.0	2.1	1.0	.9	.9	1.2
United States Employment or Reemployment Service	.7	.3	1.3	.2	.5	.5
Other public employment service	.8	.6	1.1	.4	.5	.3
Any other medium	7.2	10.2	4.8	9.6	8.6	5.4
Medium not reported	5.9	4.0	6.7	4.4	6.1	7.9

of the mechanical and industrial engineers, but by only 61.7 percent of the civil engineers. The civil engineers, however, also secured a substantial number of jobs through civil-service agencies. They were the only professional group of which this was true. Of the engineers who had engineering jobs in December 1934, 19.8 percent of the civil engineers stated that these were found through the civil service, whereas among the remaining four professional classes, the range was from only 2.5 percent for the chemical and ceramic engineers to 4.6 percent for the mining and metallurgical engineers. Thus, 2,941, or four-fifths of the total of 3,706, who used the civil service as a means to a job were civil engineers.

It will, however, be noted that personal contacts and recommendations, together with civil service, accounted for 74.2 percent of the mechanical and industrial engineers. For each of the remaining professional classes, these two media covered approximately four-fifths of their respective totals, ranging from 78.4 percent of the chemical and ceramic to 81.5 percent of the civil engineers.

In all professional groups there was a relatively high proportion of unclassified means of securing a job, although the several professional groups show marked differences. "Any other medium" may well include a substantial number placed through their colleges, a point not covered in the questionnaire and one likely to affect the percentage noted in this classification.

Although the percentage distributions for the remaining avenues to employment do not embrace large numbers of each professional class, relatively they do present some striking contrasts. Only 2.4 percent of all engineers reported that they obtained their position through an engineering society. Some 3.7 and 2.7 percent, respectively, of the mechanical and industrial, and of the mining and metallurgical engineers were so classified. For the three remaining professional classes, the percentages ranged from 1.4 to 1.9. Despite the fact that so few engineers reported an engineering society as their employment medium, it must be recognized that such societies are an important factor in obtaining employment for professional engineers. It is obvious that through their members there must inevitably be a pooling of information on employment prospects, both locally and nationally. Furthermore, the officials of the various societies are kept in close touch with local and national employment conditions as a result of their meetings and conventions; but such appointments as are made would depend rather upon personal contacts and recommendations than upon contacts made through the society's employment service. The fact, therefore, that only 2.4 percent of all engineers reported the engineering society as their medium of employment must be interpreted in the light of these conditions.

The securing of employment through newspapers and technical journals was reported by 1.6 and 1.0 percent, respectively, of all engineers making returns. It will be noted however that, relatively, electrical and mechanical and industrial engineers found more jobs through newspapers than did any of the other professional classes; this medium was reported by 1.8 percent of the electrical and 2.6 percent of the mechanical and industrial engineers, whereas among the other classes the highest percentage was 1.1. On the other hand, technical journals as a medium of employment were of more assistance to chemical and ceramic engineers (2.1 percent); among the remaining professional classes the percentages ranged from 0.9 to 1.2.

Private employment agencies were used by only 1.6 percent of all engineers reported. When considered together, the two public employment agencies embraced approximately the same proportion, namely, 1.5 percent. A similar comparison among the five professional classes showed that, relatively, public agencies were of more importance to civil engineers, of whom 2.4 percent so reported, whereas the next highest percentage was 1.0 percent for mechanical and

industrial engineers. Only 0.8 percent of the civil engineers used private employment agencies to obtain jobs, but 2.9 percent of the mechanical and industrial engineers did so; for the remaining professional classes, the percentages ranged from 1.1 to 1.9 percent.

Economic Security in the Engineering Profession

A written contract of employment and pension privileges are two important criteria of economic security. The efficacy of any such schemes, however, depends to a marked extent upon the nature of the employment. This is demonstrated by a comparison of the data concerning economic security among professional engineers who reported as being engaged in public engineering, personal service, and private engineering.

Civil-Service Status

The importance of civil-service status as a factor in stability of employment is shown in table 24.

TABLE 24.—*Distribution at end of 1934 of all engineers reporting civil-service status, by field of engineering activity and professional class*

Field of engineering activity and professional class	Number				Percentage			
	Total	Without status	With status	Not reporting	Total	Without status	With status	Not reporting
Federal Government	4,649	2,084	2,250	315	100.0	44.8	48.4	6.8
Chemical and ceramic	74	22	44	8	100.0	29.7	59.5	10.8
Civil, agricultural, and architectural	3,620	1,649	1,734	237	100.0	45.6	47.9	6.5
Electrical	306	143	138	25	100.0	46.7	45.1	8.2
Mechanical and industrial	549	240	272	37	100.0	43.7	49.6	6.7
Mining and metallurgical	100	30	62	8	100.0	30.0	62.0	8.0
State and county governments	4,438	2,487	1,604	347	100.0	56.1	36.1	7.8
Chemical and ceramic	37	30	3	4	100.0	81.1	8.1	10.8
Civil, agricultural, and architectural	4,044	2,203	1,535	306	100.0	54.4	38.0	7.6
Electrical	134	91	33	10	100.0	67.9	24.6	7.5
Mechanical and industrial	170	123	28	19	100.0	72.3	16.5	11.2
Mining and metallurgical	53	40	5	8	100.0	75.5	9.4	15.1
Municipal governments	2,090	1,028	952	110	100.0	49.1	45.6	5.3
Chemical and ceramic	54	28	23	3	100.0	51.8	42.6	5.6
Civil, agricultural, and architectural	1,617	829	709	79	100.0	51.3	43.8	4.9
Electrical	238	88	136	14	100.0	37.0	57.1	5.9
Mechanical and industrial	158	70	77	11	100.0	44.3	48.7	7.0
Mining and metallurgical	23	13	7	3	100.0	56.6	30.4	13.0

Despite the fact that 11,177 of the engineers reporting were in the employ of public authorities in December 1934, only 45.0 percent of them reported as being under civil service. The proportion of all engineers with civil-service status was 48.4 percent in the case of positions under the Federal Government, and for employment under State and county and municipal governments, 36.1 and 45.6 percent, respectively. The percentage under civil service of the engineers employed by the Federal Government was higher than in the two

other public employments, despite the very great increase in Federal Government employment by December 1934, as a result of temporary employment under the work-relief programs; it may be assumed that relatively few of the engineers so employed would be classified under civil service. Consequently, under normal circumstances, the proportion of all engineers under civil service with the Federal Government would be higher than 48.4 percent. On the other hand, with regard to the other two classes of public engineering, it will be recalled that the numbers of engineers so engaged remained comparatively stable over the period 1930–34. Hence, the proportions reported as being under civil service are representative of the situation.

The relative proportions of each professional class under civil service differed very markedly among the three classes of public engineering employment. The smallest range occurred in Federal positions—from 45.1 percent for electrical engineers to 62.0 percent for mining and metallurgical engineers. These two professional classes also constituted the extremes of the range of the proportions embraced by municipal governments, but in reverse order. Thus, of the mining and metallurgical engineers in municipal employment 30.4 percent, and of the electrical engineers 57.1 percent, had civil-service status. Relatively, the smallest numbers of each professional class under civil service were found in State and county governments. This is best exemplified by the comparative data for civil engineers; of their number, 47.9 and 43.8 percent respectively, in Federal and municipal employments, but only 38.0 percent in State and county positions, had civil-service status. But since the civil engineers comprised approximately 80.0 percent of the 5,038 engineers who were under civil service, it is obvious that such a status is a significant contributory factor to the stability of employment.

The Employment Contract

For the engineering profession as a whole, the data in table 25 clearly evidence a lack of economic security in terms of a written contract which would secure employment over a substantial period of time. In all, only 3,169, or 8.9 percent, of the 35,559 engineers who reported employment in an engineering field [2] were covered by written contract. Of these, some 0.8 percent had a contract for less than 1 year, 3.5 percent a contract for between 1 and 2 years, and only 0.9 percent for 2 years or more. Engineers who did not report as to period of contract formed 3.7 percent of the whole. No less than 91.1 percent either answered "No" or did not furnish specific information.

[2] Throughout the whole of this discussion, only engineering employment is considered. Consequently, no cognizance has been taken of the economic security of engineers engaged in nonengineering employment.

Comparison of the positive returns on employment contract from all engineers in the three broad fields of engineering activity shows that use of the contract was most common in personal service—primarily education.

For engineers under contract in the personal service field the most common contract period (reported by 25.6 percent of the 2,778 engineers so engaged) was from 1 to 2 years. Some 4.0 percent were under contract for periods of 2 years or longer. Although the corresponding percentages for public engineering were much lower than for personal service, they were higher than for private engineering. For employment contracts under 1 year, however, private exceeded public engineering (1.0 percent, as against 0.5 percent). Of all reporting engineers engaged in public engineering, 2.0 percent had contracts for 1 and under 2 years, and 1.1 percent for periods of 2 years and over. The corresponding percentages for private engineering were 1.4 and 0.5 percent.

TABLE 25.—*Distribution at end of 1934 of all engineers reporting employment contract, by field of engineering activity*

Field of engineering activity	Number						Percentage					
	Total	Under contract for—			Under contract, no period reported	Not reporting [1]	Total	Under contract for—			Under contract, no period reported	Not reporting [1]
		Under 1 year	1 and under 2 years	2 years and over				Under 1 year	1 and under 2 years	2 years and over		
All fields	35,559	295	1,234	330	1,310	32,390	100.0	0.8	3.5	0.9	3.7	91.1
Private engineering	21,604	212	298	99	637	20,358	100.0	1.0	1.4	.5	2.9	94.2
Construction	3,437	32	63	12	113	3,217	100.0	.9	1.8	.3	3.3	93.7
Extractive industries	1,841	11	21	6	60	1,743	100.0	.6	1.1	.3	3.3	94.7
Public utilities	4,183	16	21	8	50	4,088	100.0	.4	.5	.2	1.2	97.7
Transportation	1,255	5	4	2	17	1,227	100.0	.4	.3	.2	1.4	97.7
Manufacturing	10,888	148	189	71	397	10,083	100.0	1.4	1.7	.7	3.6	92.6
Public engineering	11,177	53	224	121	295	10,484	100.0	.5	2.0	1.1	2.6	93.8
Federal Government	4,649	33	42	34	181	4,359	100.0	.7	.9	.7	3.9	93.8
State and county governments	4,438	15	125	50	81	4,167	100.0	.3	2.8	1.1	1.8	94.0
Municipal governments	2,090	5	57	37	33	1,958	100.0	.2	2.7	1.8	1.6	93.7
Personal service	2,778	30	712	110	378	1,548	100.0	1.1	25.6	4.0	13.6	55.7

[1] Also includes those who reported "No," which number could not be separated in the tabulation.

For the separate fields of engineering activity under private engineering, relatively, the largest proportion of engineers under contract in their jobs occurred in manufacturing, with 408, or 3.8 percent of the 10,888, reporting as so engaged. In the construction and extractive industries 3.0 and 2.0 percent, respectively, had written contracts. The smallest proportions under contract were reported by engineers in the employ of public utilities or engaged in transportation (1.1 and 0.9 percent, respectively). There was a marked contrast in contract

status between Federal positions and those in the two other categories of public engineering. Thus, while only 2.3 percent of the 4,649 reporting engineers in Federal employ were on contract, the proportion working on this basis for State and county and for municipal governments formed respectively 4.2 and 4.7 percent of their grand totals.

The type of work in which engineers under contract were engaged is presented in table 26.

TABLE 26.—*Distribution at end of 1934 of all engineers reporting employment contract, by type of engineering work*

Type of engineering work	Number						Percentage					
	Total	Under contract for—			Under contract, no period reported	Not reporting [1]	Total	Under contract for—			Under contract, no period reported	Not reporting [1]
		Under 1 year	1 and under 2 years	2 years and over				Under 1 year	1 and under 2 years	2 years and over		
All types	34,101	288	1,196	311	1,236	31,070	100.0	0.8	3.5	0.9	3.6	91.2
Design and research	9,050	106	119	52	305	8,468	100.0	1.2	1.3	.6	3.4	93.5
Construction	8,233	39	153	63	209	7,769	100.0	.5	1.9	.8	2.5	94.3
Operation	8,276	57	79	38	148	7,954	100.0	.7	1.0	.5	1.8	96.0
Consulting	2,146	26	30	11	80	1,999	100.0	1.2	1.4	.5	3.7	93.2
Teaching	2,050	24	692	98	350	886	100.0	1.2	33.8	4.8	17.1	43.1
Sales	1,513	15	59	7	56	1,376	100.0	1.0	3.9	.5	3.7	90.9
General administration and management	2,833	21	64	42	88	2,618	100.0	.7	2.3	1.5	3.1	92.4

[1] Also includes those who reported "No," which number could not be separated in the tabulation.

In general, the distribution followed the same trend as shown in table 25, that is to say, the largest groups had written contracts for periods from 1 and under 2 years. Table 26 also confirms the previous finding that engineers engaged in teaching are relatively more secure with regard to employment than other members of the engineering profession: 33.8 percent of their number reported written contracts for periods of from 1 to 2 years. Sales employments, next in order, had under contract for a similar period only 3.9 percent of their 1,513 reporting engineers, and general administration and management only 2.3 percent. Each of the other types of work had less than 2.0 percent. Even for the contract periods of 2 years and over, teaching covered 4.8 percent of the total reported for this type of work. The next highest percentage, namely, 1.5, was reported for general administration and management. In no one of the remaining employments did the percentage of engineers with written contracts for 2 years and over exceed 0.8 percent.

Thus, with regard to fields of engineering activity or the types of work within them, the engineering profession cannot be said to have any substantial security of employment provided through a written

contract for a period of time. On the other hand, professional engineers are not generally restricted with regard to the seeking of employment similar to that in which they may be engaged. This is evidenced by a consideration of the data furnished by professional engineers concerning their separation contract status.

Tables 27 and 28 indicate the percentage of the engineers who are bound for indicated periods of time after leaving their present employ not to accept similar employment. Thus, while 8.9 percent of the engineers reported that their present employment status was protected by contract, 1.7 percent reported that they were bound by contract in some respect with reference to accepting similar employment with another employer after separation from their present job. This included 0.8 percent whose separation contracts were for less than 1 year, 0.2 percent for a period of from 1 to 2 years, and 0.4 percent for 2 years and over. Clearly, restrictions upon professional engineers with regard to new employment were few.

TABLE 27.—*Distribution at end of 1934 of all engineers reporting separation contract, by field of engineering activity*

Field of engineering activity	Number						Percentage					
	Total	Under contract for—			Under contract, no period reported	Not reporting [1]	Total	Under contract for—			Under contract, no period reported	Not reporting [1]
		Under 1 year	1 and under 2 years	2 years and over				Under 1 year	1 and under 2 years	2 years and over		
All fields	35,559	287	77	128	95	34,972	100.0	0.8	0.2	0.4	0.3	98.3
Private engineering	21,604	180	67	124	38	21,195	100.0	.8	.3	.6	.2	98.1
Construction	3,437	32	5	8	10	3,382	100.0	.9	.1	.2	.3	98.5
Extractive industries	1,841	19	1	2	4	1,815	100.0	1.0	.1	.1	.2	98.6
Public utilities	4,183	16	2	2	4	4,159	100.0	.4	(2)	(2)	.1	99.5
Transportation	1,255	2			2	1,251	100.0	.2			.2	99.6
Manufacturing	10,888	111	59	112	18	10,588	100.0	1.0	.5	1.0	.2	97.3
Public engineering	11,177	50	3	2	26	11,096	100.0	.4	(2)	(2)	.2	99.4
Federal Government	4,649	16	1	2	8	4,622	100.0	.3	(2)	(2)	.2	99.5
State and county governments	4,438	27	1		10	4,400	100.0	.6	(2)		.2	99.2
Municipal governments	2,090	7	1		8	2,074	100.0	.3	(2)		.4	99.3
Personal service	2,778	57	7	2	31	2,681	100.0	2.1	.3	.1	1.1	96.4

[1] Also includes those who reported "No," which number could not be separated in the tabulation.
[2] Less than 1/10 of 1 percent.

The purpose of the separation contract is to prevent the transfer of a special capacity to a competitor. More particularly it is designed to protect the employer's interest in secret processes and developmental research. This being so, it is difficult to account for the fact that 4.3 percent of those engaged in teaching reported a separation contract covering the obligation not to engage in similar employment for a period of time, as against the obligation to work out the period of the

TABLE 28.—*Distribution at end of 1934 of all engineers reporting separation contract, by type of engineering work*

Type of engineering work	Number						Percentage					
	Total	Under contract for—			Under contract, no period reported	Not reporting [1]	Total	Under contract for—			Under contract, no period reported	Not reporting [1]
		Under 1 year	1 and under 2 years	2 years and over				Under 1 year	1 and under 2 years	2 years and over		
All types	34,101	274	72	122	93	33,540	100.0	0.8	0.2	0.4	0.3	98.3
Design and research	9,050	68	33	62	15	8,872	100.0	.8	.4	.7	.2	97.9
Construction	8,233	45	9	2	18	8,159	100.0	.5	.1	(2)	.2	99.2
Operation	8,276	52	12	33	16	8,163	100.0	.6	.1	.4	.2	98.7
Consulting	2,146	10		9	8	2,119	100.0	.5		.4	.4	98.7
Teaching	2,050	51	6		31	1,962	100.0	2.5	.3		1.5	95.7
Sales	1,513	28	6	5	1	1,473	100.0	1.9	.4	.3	.1	97.3
General administration and management	2,833	20	6	11	4	2,792	100.0	.7	.2	.4	.1	98.6

[1] Also includes those who reported "No," which number could not be separated in the tabulation.
[2] Less than 1/10 of 1 percent.

employment contract (table 28). It seems probable that there may have been confusion in the reports. Sales and design and research are, as should be expected, the other two types of work in which the separation contract appears most frequently. But whereas 2.7 percent of those engineers in sales work reported a special contractual limitation upon taking up similar work with another employer, the period to which they bound themselves was generally less than 1 year. In design and research a smaller percentage, 2.1 percent, were bound by a special separation contract but in one-third of the cases the period specified was 2 years or more, and was over a year in more than half the cases where such a contract existed. In construction, of course, such contracts are least frequently reported and again are for periods of less than a year.

Provision for Retirement on Pension

An analysis of the data furnished by professional engineers concerning their pension privileges is presented in table 29.

As of December 1934 almost one-third (10,641) of the 35,559 professional engineers reporting who had engineering jobs at that time stated that they had pension privileges. Of this number, 6,684, or 18.8 percent, were covered by contributory pension schemes, and 3,957, or 11.1 percent by noncontributory schemes. Some 57.8 percent were in employments for which no pension provision had been made. About 12.3 percent did not furnish information.

Of the engineers in pensionable positions, the smallest relative proportion, 26.2 percent, were engaged in private engineering. By contrast, 37.4 percent of the engineers engaged in public engineering

TABLE 29.—*Distribution at end of 1934 of all engineers reporting pension privileges, by field of engineering activity*

Field of engineering activity	Number					Percentage				
	Total	No pension	Pension privileges		Not reporting	Total	No pension	Pension privileges		Not reporting
			Contributory plan	Noncontributory plan				Contributory plan	Noncontributory plan	
All fields	35,559	20,556	6,684	3,957	4,362	100.0	57.8	18.8	11.1	12.3
Private engineering	21,604	13,207	2,265	3,387	2,745	100.0	61.1	10.5	15.7	12.7
Construction	3,437	2,445	174	138	680	100.0	71.1	5.1	4.0	19.8
Extractive industries	1,841	1,109	272	200	260	100.0	60.2	14.8	10.9	14.1
Public utilities	4,183	1,833	341	1,555	454	100.0	43.7	8.2	37.2	10.9
Transportation	1,255	576	120	416	143	100.0	45.9	9.6	33.1	11.4
Manufacturing	10,888	7,244	1,358	1,078	1,208	100.0	66.5	12.5	9.9	11.1
Public engineering	11,177	5,791	3,827	357	1,202	100.0	51.8	34.2	3.2	10.8
Federal Government	4,649	1,850	2,009	248	542	100.0	39.8	43.2	5.3	11.7
State and county governments	4,438	2,723	1,193	58	464	100.0	61.3	26.9	1.3	10.5
Municipal governments	2,090	1,218	625	51	196	100.0	58.3	29.9	2.4	9.4
Personal service	2,778	1,558	592	213	415	100.0	56.1	21.3	7.7	14.9

and 29.0 percent of those in personal service had pension privileges. It will also be noted that for public engineering and personal service the contributory scheme predominated. On the other hand, of the engineers engaged in private engineering, the largest proportion was covered by noncontributory systems. However, within the private-engineering group marked differences were shown; the same was true of the three categories of public engineering.

The largest number of professional engineers covered by a pension plan were those in the employ of the Federal Government. Out of a total of 4,649 engineers in Federal employment reporting, 43.2 percent were under a contributory and only 5.3 percent under a noncontributory plan. The corresponding proportions in positions with State and county, and municipal governments were very much less—26.9 and 1.3 percent, and 29.9 and 2.4 percent, respectively. This order of difference parallels that of the proportions of engineers under civil service in these three classes of employment, but only in the case of the Federal Government are the two proportions closely related. This arises from the fact that, whereas all persons under Federal civil service must contribute to the retirement fund, this is not true to the same extent for employments under State and county, and municipal governments, where age, length of service, and salary are also taken into consideration.

Among the remaining fields of engineering activity, public utilities and transportation reported the next highest proportions (after Federal employment) as having pension privileges. Public utilities and transportation used the noncontributory scheme; this type of plan covered

37.2 percent in utilities and 33.1 percent in transportation; contributory systems covered only 8.2 and 9.6 percent, respectively, of those reporting. For the three remaining pursuits shown under private engineering, the largest number of engineers with pension privileges did not exceed 25.7 percent, and in all cases contributory schemes predominated.

From the preceding discussion of the pension privileges it is quite evident that the kind of employment has a marked effect upon the question of the installation of a pension scheme. In no type of engineering employment was a majority of the reporting engineers protected by such a plan.

Chapter VI

Unemployment in the Engineering Profession, 1929 to 1934

Although unemployment has for decades been recognized as a major form of insecurity affecting wage earners, it was not formerly regarded as an immediate problem of the professional worker. Fairly reliable data concerning wage-earner unemployment have been made available from time to time, but for professional workers little more has been known than that in this depression unemployment grew to such proportions among professional workers as to constitute a major problem. It is, therefore, of fundamental interest to trace in more detailed form how engineers fared in regard to unemployment during the depression.

This survey of the engineering profession presents for the first time a substantially reliable picture of the incidence of unemployment upon a professional group. There are unfortunately no comparable data for the other professions. The information furnished[1] has made it possible to measure not only the proportions who were unemployed at the end of each of the 3 years covered in the survey, but also to measure the incidence of unemployment over the 5-year period and the duration of such unemployment. The extent of relief is also measured.

Unemployment at End of 1929, 1932, and 1934

The first part of the discussion will be concerned with trends in unemployment. For the country as a whole there was an appreciable decrease in unemployment among professional engineers between December 31, 1932, and December 31, 1934. Thus, while the proportion unemployed on December 31 rose from 0.7 percent in 1929 to 10.1 percent in 1932, it had declined to 8.5 percent by 1934 (table 30).

[1] See questions 6 and 7 of the questionnaire. (Appendix A, p. 214.)

TABLE 30.— *Percentage of engineers reporting unemployment* [1] *at end of 1929, 1932, and 1934, by professional class*

[Figures adjusted as explained on p. 34]

Professional class	Percentage unemployed on Dec. 31—		
	1929	1932	1934
All classes	0.7	10.1	8.5
Chemical and ceramic	.5	8.6	6.2
Civil, agricultural, and architectural	.7	10.0	10.2
Electrical	.5	10.0	7.4
Mechanical and industrial	.7	10.7	7.3
Mining and metallurgical	2.0	10.2	8.3

[1] Includes direct relief and work relief.

It has already been shown that the decreases in unemployment among engineers from 1932 to 1934 do not imply an increase in the proportion engaged in engineering activities. While a larger proportion of the engineers were employed in 1934 than in 1932, the gain, if all professional classes are considered in combination, occurred in nonengineering work. Increases of nonengineering employment were particularly important to electrical engineers. Only in the case of mining and metallurgical engineers was there a large increase in the percentage reporting engineering employment.

The most striking fact in table 30 is the narrow range in the proportions of unemployment among the various professional groups for each of the three periods. This is especially true for 1932 with a range of from 8.6 percent for the chemical and ceramic engineers group to 10.7 percent for mechanical and industrial engineers.[2]

In 1929, although 2.0 percent of the mining and metallurgical engineers reported unemployment, the range for the remaining professional classes was only from 0.5 to 0.7 percent. The fact that mining and metallurgical engineers differed so markedly probably indicates that they were affected earlier by the drop in business activity.

So also in 1934 there is a narrow range for all professional groups, except civil engineers. In their case the proportion of unemployment increased from 10.0 to 10.2 percent, which presumably reflects less building in 1934 than in 1932. The unemployment situation among the remaining professional classes improved the most in the case of mechanical and industrial engineers.

By type of education.—The type of education the engineer had received affected the extent of unemployment (table 31). Thus, in

[2] This is especially noteworthy because, according to the Federal Reserve Board indexes for 1929 and 1932, general manufacturing activity declined from 119 to 63; manufacturing wage-earner employment from 105 to 65; whereas building permits for nonresidential construction decreased from 142 to 40. In part, the stability of employment among civil engineers was due to the large proportion in public employment. The high instability among mechanical engineers may have been due to a relatively large employment in the "heavy industries" where the index of wage-earner employment declined from 103.7 to 51.3. But the 1932 data do indicate an apparently extensive interrelationship of activity for various professional classes.

1932 the proportion of all postgraduates who were unemployed was only two-thirds that of graduates with a first degree in engineering. Among chemical engineers and mechanical engineers, the difference in favor of the postgraduates was greatest. The smallest difference occurred among civil engineers. The same characteristic relationships occurred in 1934, though, for all but civil engineers, in each case the decrease in unemployment was marked.

There is no clear evidence in this table of a relationship between the extent of unemployment among those engineers whose college work was incomplete, or who attended noncollegiate technical schools, and those who had first degrees.[3]

TABLE 31.—*Percentage of engineers reporting unemployment* [1] *at end of 1929, 1932, and 1934, by type of education and professional class*

[Figures adjusted as explained on p. 34]

Professional class	Percentage unemployed on Dec. 31—											
	1929				1932				1934			
	Postgraduates	First-degree graduates	College course incomplete	Noncollegiate technical course	Postgraduates	First-degree graduates	College course incomplete	Noncollegiate technical course	Postgraduates	First-degree graduates	College course incomplete	Noncollegiate technical course
All classes	0.5	0.7	0.9	1.1	7.5	10.5	10.4	11.1	5.8	8.7	10.3	10.0
Chemical and ceramic	------	.4	1.6	-------	5.8	9.7	-------	-------	2.6	7.2	-------	------
Civil, agricultural, and architectural	.5	.7	.8	1.4	9.2	10.1	10.2	11.7	8.8	10.2	11.9	13.3
Electrical	.8	.3	.6	1.4	7.3	10.6	9.6	10.3	4.8	7.5	9.3	8.6
Mechanical and industrial	.5	.8	.9	.4	6.0	11.0	11.9	10.5	4.3	7.8	8.2	6.3
Mining and metallurgical	.7	2.1	2.1	3.8	8.8	11.2	8.3	9.6	7.2	8.9	8.4	11.2

[1] Includes direct relief and work relief.

By age.—The outstanding feature of table 32 is that a larger proportion of the older engineers remained unemployed on December 31, 1934, than was true of those graduating from 1905 to 1932. In the table the engineers are classified on the basis of their age in 1934. The first four groups shown in the table include both engineers without college degrees who were over 28 in 1934, and those who graduated prior to 1930. The last two groups shown entered the profession during the depression and, therefore, could not have been employed in December 1929. As of December 31, 1929, the percentage range

[3] The striking lower percentages of unemployment among secondary-school engineers, namely, 6.6 in 1932 and 3.4 in 1934, are not shown in the table because the number of cases is small, and because it may be that some secondary-school engineers ceased to be engineers when unemployed. This may have also been the case even for the college incomplete and noncollegiate technical-school engineers.

Percentages for nongraduate chemical engineers have been omitted from table 31. They are based on such a small number of cases as probably to be without significance. The percentages are: For engineers whose college training course was incomplete, 7.9 in 1932 and 5.8 in 1934; for those with noncollegiate technical-school training, 25.0 in 1932 and 23.8 in 1934.

of unemployment was from 0.4, in the case of the youngest engineers, to 1.9 for engineers 48 years and over as of that period, and 53 years or over as of 1934.

By December 1932 unemployment had increased markedly for all age groups. Unemployment was least (8.0 percent of the total) for engineers 31 to 40 years of age in 1932 (33 to 42 years of age in 1934). Unemployment rose to 10.9 percent among the oldest engineers, those over 50 years of age in 1932. The possibility of voluntary retirement makes it impossible to determine whether the proportion unemployed at the end of the year was larger among the oldest group of engineers than among those who were 26 to 30 years of age in 1932, 10.6 percent of whom were unemployed. The youngest group, composed for the most part of those who attempted to enter the profession after graduation in the depression years of 1930–32, had the largest unemployment at that time; on December 31, 1932, one-sixth of them were unemployed.

TABLE 32.—*Percentage of all engineers reporting unemployment* [1] *at end of 1929, 1932, and 1934, by age and year of graduation* [2]

Approximate age in 1934 of engineers and year of graduation	Percentage unemployed on Dec. 31—		
	1929	1932	1934
53 years of age and over, and graduates prior to 1905	1.9	10.9	11.5
43 to 52 years of age, and graduates during 1905–14	.7	8.7	8.1
33 to 42 years of age, and graduates during 1915–24	.4	8.0	7.0
28 to 32 years of age, and graduates during 1925–29	.4	10.6	7.0
25 to 27 years of age, and graduates during 1930–32	----	16.6	8.0
23 to 24 years of age, and graduates during 1933–34	----	----	13.9

[1] Includes direct relief and work relief.

[2] In order to obtain a datum whereby direct comparisons could be made between engineers with and without degrees, the median age of graduation among the several professional classes was computed. This was found to be 23 years. Consequently, the data were so tabulated to permit of grouping by years of graduation and corresponding year of birth for each of the periods 1929, 1932, and 1934. In this table, engineers with college degrees in the years indicated are combined with "other" engineers of the ages given in the table.

Further inspection of table 32 shows very clearly that by December 1934 many of the older engineers were still unable to obtain work, and there is a very strong presumption that the preference in new hirings was given to the younger men. This is partly explicable on the grounds that: First, the older engineers probably were in a better position financially to weather the continuing depression; and second, the available professional employment opportunities were of such a nature as not to be in keeping with their experience or their customary salary status. In any event, it will be observed that unemployment among those who graduated [4] in 1925 to 1929 was cut from 10.6 percent in December 1932 to 7.0 percent in December 1934. The proportion of those who had graduated from 1930 to 1932 and were unemployed on December 31, 1932, was cut in half by December 31,

[4] Includes also corresponding group (i. e., 28–32 years), the year of graduation and age being used interchangeably.

1934. By way of contrast, the percentage of unemployment among those 41 to 50 years of age in 1932 was reduced from 8.7 percent in 1932 to 8.1 percent in 1934. The proportion of those over 50 in 1932 reporting unemployment rose from 10.9 percent in December 1932 to 11.5 percent in December 1934.[5]

TABLE 33.—*Percentage of engineers reporting unemployment*[1] *at end of 1929, 1932, and 1934, by age, year of graduation, and professional class*

Approximate age in 1934 of engineers and year of graduation	Percentage unemployed on Dec. 31—				
	1929				
	Chemical and ceramic	Civil, agricultural, and architectural	Electrical	Mechanical and industrial	Mining and metallurgical
53 years of age and over, and graduates prior to 1905	0.7	1.7	2.2	1.8	3.6
43 to 52 years of age, and graduates during 1905–14	.5	.9	.3	.6	2.2
33 to 42 years of age, and graduates during 1915–24	.5	.4	.3	.2	1.3
28 to 32 years of age, and graduates during 1925–29	.3	.3	.4	.6	.5
25 to 27 years of age, and graduates during 1930–32					
23 to 24 years of age, and graduates during 1933–34					
	1932				
53 years of age and over, and graduates prior to 1905	3.9	11.2	10.0	11.3	12.8
43 to 52 years of age, and graduates during 1905–14	7.0	8.8	7.1	9.6	9.6
33 to 42 years of age, and graduates during 1915–24	5.0	8.9	6.6	8.7	6.0
28 to 32 years of age, and graduates during 1925–29	8.8	10.2	9.9	11.9	12.4
25 to 27 years of age, and graduates during 1930–32	15.8	14.7	20.2	15.6	17.5
23 to 24 years of age, and graduates during 1933–34					
	1934				
53 years of age and over, and graduates prior to 1905	5.9	12.3	11.4	10.2	14.2
43 to 52 years of age, and graduates during 1905–14	4.1	9.0	7.3	7.7	7.5
33 to 42 years of age, and graduates during 1915–24	4.4	8.9	5.5	6.0	6.2
28 to 32 years of age, and graduates during 1925–29	5.5	9.2	5.3	6.0	7.5
25 to 27 years of age, and graduates during 1930–32	4.9	11.5	6.9	5.8	6.1
23 to 24 years of age, and graduates during 1933–34	11.9	18.0	14.6	10.4	10.7

[1] Includes direct relief and work relief.

Evidence of the improved employment opportunity for younger men between the end of 1932 and 1934 is also shown in the smaller percentage of unemployment among the most recent graduates. More than a sixth[6] of those graduating in 1931–32 were unemployed on December 31, 1932. On December 31, 1934, the plight of the newcomer was still hard, worse than that of any of the group that had

[5] The criticism has been made that the percentages of unemployment shown in the table relate to the indefinite group of those "53 and over." The figures would presumably be smaller if the group were closed at 62 years of age. It is quite certain from the contour of the percentages both in 1932 and 1934 that the percentage continues to rise with age. It is also certain that the high percentages shown are due to the persistence of unemployment when it occurs, rather than to a rising risk of unemployment.

[6] It is impossible to say how much more; the 16.6 percent, shown in the table, includes 193 0graduates as well.

"experience";[7] nevertheless, the percentage of unemployment among those graduating in 1933–34 was 13.9, a better record than the corresponding one in 1932 for 1931–32 graduates.

These findings are borne out by table 33, in which the same type of information is presented for each of the five professional groups of engineers. In each of these groups, with the possible exception of the chemical engineers, the percentage of unemployment at all three dates was higher for those who were 53 years of age or over in 1934 than for the younger men who entered the profession in the period 1925–29.

In chemical engineering, long experience appears to have been particularly valued. A smaller proportion of the chemical engineers in the group over 50 years of age in 1932 were unemployed in December 1932 than in any of the other age classes. The brunt of unemployment in this profession was being borne by those who graduated in 1925 or later. Chemical engineers graduating from 1905 to 1932 had only a slightly more favorable experience as regards unemployment than those of similar ages in the other professions. In the period from 1932 to 1934, the percentage of unemployment among chemical engineers was materially reduced among all groups graduating after 1905 but rose in the case of the oldest group. It is noteworthy, however, that the proportion of unemployment was only half as great among the oldest group of chemical engineers in 1934 as in any of the other professional classes, and was only slightly larger than the proportion of unemployment among the younger chemical engineers.

In electrical engineering, also, engineers who entered the profession in 1925 or later were more likely to be unemployed in December 1932 than were those who entered the profession before 1925. But in December 1934, the percentage of the oldest electrical engineers who were unemployed was about the same as that for the group graduating in the period 1925–29. From December 1932 to 1934, the total percentage of electrical engineers who were unemployed declined, but there was a rise from 10.0 percent to 11.4 percent among engineers in the oldest group. This group reported twice as large a proportion of unemployment in December 1934 as did the group graduating during the period 1925–29. Mechanical engineering shows a somewhat similar pattern to that just described for electrical engineering, except that unemployment declined slightly from 1932 to 1934 in the oldest group.

Mining and metallurgical engineering followed closely the general trend in 1929 and 1932. In 1934, however, unemployment was lowest in the group 33 to 42 years of age, and rose somewhat in the group over 42 years of age. Among those 53 years of age and over,

[7] Note, however, that the engineering graduate had a better opportunity of employment than the general male population of an industrial State. Of the male population of Massachusetts 21–24 years of age who either had a job or were looking for a job on Jan. 1, 1934, 33.7 percent were unemployed.

14.2 percent were unemployed—a substantially higher figure than for this age group in any of the other professional classes.

The relationship of unemployment to age in the case of the civil, agricultural, and architectural group of engineers followed the general trend in 1929 to 1932. This class, however, showed less improvement in employment opportunity between 1932 and 1934 than did the other professional classes. The fact that the general percentage of unemployment continued to rise for civil engineers led to a distinctive pattern of unemployment by age groups for this profession in 1934. The largest percentage of unemployment was still found among those who had come to the profession most recently, but from December 1932 to December 1934 there was a decline in unemployment among those who graduated between 1925 and 1932. The extent of unemployment in 1934 remained unchanged among civil engineers 33 to 42 years of age, but increased among those 43 years of age and over.

In 1932 all classes of engineers who attempted to enter the profession in the period 1930–32 had similar experiences. About 15 percent of these chemical engineers, civil engineers, and mechanical engineers were unemployed on December 31, 1932, as were 17.5 percent of the mining and metallurgical engineers and 20.0 percent of the electrical engineers. The proportions of those unemployed declined more in this age group from 1932 to 1934 than in any other age group. By 1934, the unemployment of these newcomers was essentially the same as for those who graduated prior to 1929.

Civil engineers alone showed a relatively small improvement as regards unemployment for those graduating from 1930–32. It will be recalled (table 30) that the percentage of unemployment for all civil engineers rose from 10.0 in December 1932 to 10.2 in 1934. A rise in the percentage unemployed in 1934 occurred for those over 43 years of age; and was as great in 1934 as in 1932, for those who were 33 to 42 years old. Those graduating in the years 1925–29 showed a decline, in proportion unemployed, from 10.2 to 9.2 percent. Additions to the ranks of civil engineers were mainly from among the newcomers, in the two depression years of 1932 and 1934. Unemployment among the 1930–32 graduates fell from 14.7 to 11.5 percent.

In summary, this analysis of trends shows (1) that there was a distinct improvement in the unemployment status of professional engineers between December 31, 1932, and December 31, 1934; (2) that there were but slight differences in the incidence of unemployment among the various professional classes in 1932 and, except for civil engineers, in 1934; (3) that engineers who had received postgraduate degrees fared better than engineers with other types of training; and (4) that as between older and younger engineers, the former not only felt the effect of the drop in business activity earlier than the latter but unquestionably were still lagging, at least until

December 31, 1934, in the return to professional activity. In general it may be said that in this period of contraction of business activity, the inexperienced newcomer had greater difficulty in securing a professional status than any other class, that those with 5 to 25 years' experience fared best as regards unemployment, and that there was little difference (except in the case of chemical engineers) in the percentages of unemployment at a given date between those with less than 5 years' experience and those with more than 25 years' experience.

In a period of expansion the younger and the more inexperienced engineers have a definite advantage. The normal method of recruitment at the bottom is followed. It is to be noted from table 33 that by December 31, 1934, the percentage of unemployment in all professional classes showed little variation between the age groups that entered the profession as late as 1932 and those with an upper limit of 53 years of age. However, there is evidence that in the 4 largest professional classes unemployment continued to be relatively high among the group of engineers who were more than 53 years of age in 1934.[8]

Incidence of Unemployment, 1930 to 1934, Inclusive

The preceding discussion traced the general trend of unemployment which prevailed among professional engineers over the period from December 31, 1929, to December 31, 1934. The percentages referred to the number unemployed as of given dates. They gave no measure either of the number who were unemployed at other times during the 5-year period or of the length of unemployment. Light is shed on these points by the data obtained as to the period of unemployment, i. e., the number of months during which the engineers were on work relief [9] or were without work of any kind. The data in this section, therefore, afford a measure of the gross or over-all period of displacement from regular employment, without regard to the mitigating effects of the various types of relief.

[8] While it is theoretically possible that part of this larger unemployment for the oldest group shown may be due to retired members of the profession who have maintained membership in engineering societies, the extent of the difference appears to indicate in fact that even in 1929 there was greater unemployment among the more experienced engineers.

The method of sampling used involved the compilation of a mailing list from the past and present membership of engineering societies. Undoubtedly, there are a certain number of retired engineers who reported unemployment in reply to the question as to type of employment. As there was no specific heading, "retirement," a retired engineer had the alternative, in replying to the question on employment, of reporting himself as unemployed, reporting himself engaged in nonengineering work, or leaving the question unanswered. From the internal evidence in table 31 and in other tables it appears that retirement is not a sufficiently important factor to explain the differences in the percentages of unemployment as between the younger and the older engineers. This is most convincingly illustrated in tables 34 and 35 which show, not the number of unemployed at a particular date, but the total number unemployed in the 5-year period following Jan. 1, 1930. In these tables, the percentage for the oldest group of engineers, is no larger than it is for the group aged 43–52, and is smaller than the percentage for any of the younger engineers. Furthermore, the consistency of the movements shown in table 32 would indicate that retirement is not a dominating influence.

[9] Excluding work on P. W. A. projects and in nonrelief administrative positions in the public service.

More than 34 percent of all the engineers reporting were unemployed at one time or another within these 5 years, as against about 10 percent who were unemployed on December 31, 1932. The percentage who reported unemployment at some time during the 5 years, January 1, 1930, to December 31, 1934, with a classification by age and type of education, is shown in table 34. For all graduates combined, including those with postgraduate degrees, no less than 33.9 percent experienced unemployment. This percentage differs but slightly from the general average of 35.4 and 35.6 percent, respectively, for engineers who did not complete a college course and for engineers with a noncollegiate technical-school training.[10] This slightly lower incidence of unemployment for the "other" engineers is explicable on two grounds: (1) As a statistical "freak," arising out of slight differences in the age distribution of graduates and "other" engineers, and (2) the longer experience record of "other" engineers, for the graduate sample is especially heavily weighted by newcomers to the profession during the depression period 1930–34. For each particular age group shown in the table there is a slightly higher percentage of unemployment.

It is evident from this table that unemployment was greatest among the newcomers to the profession and decreased with the age of the engineer. In all professional groups there appeared an age beyond which there was apparently a common risk of unemployment. (Table 35.) That age varies among the several professional classes. For civil engineers it was 43 years, whereas for electrical, and mechanical and industrial engineers it occurred after 33 years of age.[11]

It will be noted that in the case of the 2 youngest age groups the percentages affected by unemployment are practically the same for all 3 types of education, with roughly half of the engineers who entered the profession during the depression period reporting some period of unemployment.

These findings seem definitely to extend the conclusions reached earlier as regards the influence of educational background. Table 31 showed less unemployment in 1932 and 1934 among those with postgraduate degrees than among those with first degrees, but there were no decisive differences in the over-all figures between first-degree graduates and "other" engineers. It may now be stated that this was due to the age composition of the two groups, for when age is considered (table 34) the older college graduate does appear to have an advantage.

[10] The table does not show the percentage of unemployment among engineers with only a secondary-school education, for their number was too small to warrant classification by age. The percentage of unemployment among all such engineers was 22.6.

[11] These are the ages as of the end of the 5-year period, 1930–34.

TABLE 34.—*Percentage distribution of all engineers reporting a period of gross* [1] *unemployment, 1930 to 1934, by age* [2] *and type of education*

[Figures adjusted as explained on p. 34]

Graduating class	Age (in years) in 1934	College graduates: Percentage reporting unemployment
All graduating classes		33.9
Entered profession during 1930–34:		
Graduated in—		
1933–34	23–24	47.1
1930–32	25–27	53.5
Entered profession in 1929 or earlier:		
Graduated in—		
1925–29	28–32	36.0
1915–24	33–42	27.1
1905–14	43–52	23.8
Prior to 1905	53+	23.5

Year of birth	Age (in years) in 1934	"Other" engineers with—	
		College course incomplete	Noncollegiate technical course
		Percentage reporting unemployment	
All ages		35.4	35.6
Entered profession during 1930–34:			
Born in 1910–14	20–24	47.9	48.2
Entered profession in 1929 or earlier:			
Born in—			
1907–9	25–27	50.0	47.6
1900–6	28–34	41.6	43.8
1895–99	35–39	33.4	34.1
Prior to 1895	40+	30.4	32.3

[1] Includes direct relief and work relief.

[2] It will be noted that the age groups of "other" engineers shown in the table differ slightly from those shown in table 36. The latter, however, correspond to those shown in appendix F, p. 229, table 1. This difference is due to the fact that the age groups in table 36 were used in the original tabulation of the data. The age groups in tables 34 and 35 were derived from the former by hand tabulation to obtain a better comparison by age with the graduates 25–27 years of age.

For further consideration of the incidence of unemployment by age, the data in table 34 are shown for two distinct groups of engineers, those entering the profession during the depression years 1930–34 and the four older groups who had entered the profession prior to 1930. These four older groups had a common experience as regards the period during which they were exposed to the risk of unemployment. On the other hand, the younger engineers were exposed to a shorter period of risk, a factor which is of great importance when the length of their employment is considered. They were also subjected to the necessity of making their way into the profession under singularly difficult conditions. Length of exposure appears to have been a factor even as regards the general incidence of unemployment, for a slightly larger proportion of those who graduated in the period 1930–32 were unemployed during this 5-year period than was the case for those graduating in 1933–34.

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TABLE 35.—*Percentage distribution of graduate and college course incomplete engineers reporting gross[1] unemployment, 1930 to 1934, by age[2] and professional class*

[Figures adjusted as explained on p. 34.]

Graduating class or year of birth	Age (in years) in 1934	Percentage reporting unemployment				
		Graduate engineers				
		Chemical and ceramic	Civil, agricultural and architectural	Electrical	Mechanical and industrial	Mining and metallurgical
All graduating classes		29.2	38.0	31.6	31.0	30.2
Entered profession during 1930–34:						
Graduated in—						
1933–34	23–24	40.3	55.1	48.9	40.7	45.6
1930–32	25–27	44.3	59.7	54.7	48.5	54.7
Entered profession in 1929 or earlier:						
Graduated in—						
1925–29	28–32	29.8	41.9	31.3	34.2	33.7
1915–24	33–42		34.4	19.6	25.4	
1905–14	43–52	15.1	26.8	17.2	24.7	23.9
Prior to 1905	53+		27.0	17.1	23.3	
		Engineers with college course incomplete				
All ages		(3)	39.1	(3)	[4] 31.2	(3)
Entered profession during 1930–34:						
Born in 1910–14	20–24	(3)	55.9	(3)	[4] 41.8	(3)
Entered profession in 1929 or earlier:						
Born in—						
1907–9	25–27	(3)	60.3	(3)	[4] 41.1	(3)
1900–6	28–34	(3)	46.4	(3)	[4] 36.7	(3)
1895–99	35–39	(3)	37.8	(3)	[4] 29.3	(3)
Prior to 1895	40+	(3)	33.3	(3)	[4] 26.3	(3)

[1] Includes direct relief and work relief.
[2] It will be noted that the age groups of "other" or nongraduate engineers shown in the table differ slightly from those shown in table 36. The latter, however, correspond to those shown in Appendix F, p. 229, table 1. This difference is due to the fact that the age groups in table 36 were used in the original tabulation of the data. The age groups in tables 34 and 35 were derived from the former by hand tabulation to obtain better comparison by age with the graduates 25–27 years of age.
[3] Included with mechanical and industrial.
[4] Includes chemical and ceramic, electrical, and mining and metallurgical.

In the case of the four older groups, all entering the profession before 1930, the largest percentage of unemployment occurred among those who entered slightly before the beginning of the depression. There appears to have been no greater incidence of unemployment among the engineers 53 years of age and over than there was among those 43 to 52 years of age. Therefore, relating this analysis to the preceding discussion of table 33, it can only be concluded that the higher percentage of unemployment for the oldest age groups as of December 31, 1932, and as of December 31, 1934, is due not to the more frequent occurrence of unemployment but to the greater length of the period of unemployment when loss of position occurs.

These findings as regards the extent of unemployment among engineers in general are confirmed by analysis of the separate professional

classes of engineers.[12] Thus, table 35 shows that for the country as a whole, approximately two-fifths of the civil engineers reported some unemployment within the 5 years covered, whereas slightly less than one-third so reported in the other professional classes. Of the engineers with college degrees the lowest proportion was 29.2 percent, for chemical and ceramic engineers; the highest was 38.0 percent, for civil, agricultural, and architectural engineers. Among those with an incomplete college course, 39.1 percent of the civil engineering group reported unemployment, whereas only 31.2 percent of the remaining engineers so reported.

At all ages civil engineering showed the greatest unemployment. Thus, among engineers graduating in 1930 to 1932, 59.7 percent of the civil engineers reported unemployment at some time during the 5 years covered. The next highest percentage, 54.7, was found among electrical, and mining and metallurgical engineers. Among civil engineers graduating prior to 1914, approximately 27 percent reported unemployment, whereas approximately 24 percent of the mechanical and industrial, and mining and metallurgical engineers so reported. So also examination of those with an incomplete college course shows unemployment persistently higher for civil engineers than for other professional groups in every age category.

The unemployment experience of civil engineers graduating in 1914 or earlier differed only slightly from that found in the case of mechanical and industrial, and mining and metallurgical engineers. In electrical engineering[13] and chemical engineering the proportion unemployed was distinctly less among the older engineers, amounting to about 17 percent in the case of electrical engineers and to less than 15 percent[14] in the case of chemical engineers.

[12] It should be noted that in the case of all graduate engineers, it was necessary to make certain combinations of professional classes. Thus, a small number of ceramic engineers were combined with chemical engineers. Civil, agricultural, and architectural engineers were combined, but the group was dominated by civil engineers. Mechanical and industrial engineers were combined, as were also mining and metallurgical engineers. In the case of the "other" engineers there were too few cases of noncollegiate technical-school graduates to warrant tabulation of the period of unemployment by both age and professional class; hence, only the data for those whose college course was incomplete were tabulated. This group has been divided to distinguish civil, agricultural, and architectural engineers from mechanical and all other classes of engineers. Inasmuch as the unemployment experience of civil engineers differed from that of all other classes, this grouping into two categories makes possible general comparisons between the unemployment experience of graduate engineers and those with an incomplete college course. The percentages of these various professional classes of engineers who reported unemployment at some time during the 5-year period, 1930–34, are shown in table 35 by the age groupings heretofore shown.

[13] The high general average for electrical engineers shown in the table is due to an especially high rate among the newcomers to the profession.

[14] The figure of 15.1 percent for chemical engineers covers all those graduating prior to 1924. Table 31 suggests that this figure would be slightly lower if it referred only to the graduates of the pre-war years.

Periods of Unemployment, 1930 to 1934, Inclusive

"Gross unemployment" is used in this section to cover periods of work relief or periods without work of any kind. The figures show the median periods of unemployment.[15]

Table 36 shows the median periods of unemployment, by age, education, and professional classes, during the 5-year period. In connection with the age classifications shown, it is important to remember the period of exposure to the possibility of unemployment. Thus, to the hazard of unemployment, engineers graduating from college in 1933 had a maximum exposure of 18 months and those graduating in 1934 a maximum exposure of 6 months, before the close of the period

TABLE 36.—*Median period of gross[1] unemployment, 1930 to 1934, by age, type of education, and professional class*

[Figures adjusted as explained on p. 34]

Graduating class	Age (in years) in 1934	Period of gross unemployment (in months) of—					
		Graduate engineers					
		All classes	Chemical and ceramic	Civil, agricultural, and architectural	Electrical	Mechanical and industrial	Mining and metallurgical
All graduating classes		12.2	9.8	12.8	12.1	12.1	13.7
Entered profession during 1930–34:							
Graduated in—							
1933–34	23–24	7.5	7.0	7.9	7.7	7.1	6.0
1930–32	25–27	11.9	10.6	11.9	13.2	11.1	11.9
Entered profession in 1929 or earlier:							
Graduated in—							
1925–29	28–32	12.1	11.1	12.2	12.4	12.0	11.7
1915–24	33–42	13.4		12.9	14.1	15.2	
1905–14	43–52	17.8	11.4	17.0	20.7	18.5	17.4
Prior to 1905	53+	23.1		22.9	25.3	22.2	

Year of birth	Age (in years) in 1934	Period of gross unemployment (in months) of—			
		Other engineers			
		College course incomplete			Noncollegiate technical course
		All classes	Civil, agricultural, and architectural	Mechanical and others	
All ages		16.3	15.8	16.9	17.3
Entered profession during 1930–34:					
Born in—					
1910–14	20–24	12.5	13.8	11.4	15.0
1905–9	25–29	14.0	13.9	14.3	15.3
Entered profession in 1929 or earlier:					
Born in—					
1900–04	30–34	14.2	13.2	15.1	16.0
1895–9	35–39	14.6	14.1	15.3	14.7
Prior to 1895	40+	19.4	18.3	22.0	19.2

[1] Includes direct relief and work relief.

[15] In other words, the middle point, half of the engineers having had a longer period and half a shorter period of unemployment.

studied (Dec. 31, 1934). On the other hand, all four groups of engineers who graduated prior to 1929 were exposed to the possibility of depression unemployment for the full period of 5 years.

There are significant differences in the period of unemployment as among the various age groups of engineers and as among engineers with different types of educational background. There are real differences among the several classes of engineers, but professional class had a less marked influence on the average period of unemployment than either age or educational background.

For the country as a whole, as indicated in table 36, the median period of unemployment for engineers who were college graduates was 12.2 months. For engineers who did not complete their college course, it was 16.3 months and for those with a noncollegiate technical-school education, it was 17.3 months.[16] The influence of educational background appears to be persistent whether the data are classified for each of the professional classes or for all engineers combined. However, the difference of over 4 months in the median period shown in table 36 as between all college graduates without regard to age and all those whose college course was incomplete exaggerates the spread. It may be that there was no spread in the case of the older engineers; the impossibility of making identical age groupings prevents any other conclusion than that, in the case of older engineers, educational background is no longer a determining factor. Comparison of the median period of unemployment in similar brackets beginning with the engineers who were approximately 30 years of age in 1934 indicates that unemployment lasted only 1 or 2 months longer in the case of those with an incomplete college record. Although in the case of the two youngest groups of engineers the college graduate appears to have had some advantage, there is reason to believe that the difference between an average period of 7½ months for the graduates of the classes of 1933–34 and 12½ months for those 20 to 24 years of age with an incomplete college record is due in large part to the fact that the latter group had a longer work history and consequently a longer period of exposure. For civil engineers classified on an age basis there was also a persistently longer period of unemployment for those with an incomplete college record.

As between the two types of "other" or nongraduate engineers, the difference of 1 month (i. e., between 16.3 months and 17.3 months) in the average appears to arise from the experience only of the younger engineers. For those over 35 years of age in 1934, there was no difference. In the younger age groups the differences ranged from 1.3 months to 2.5 months, and in all cases, those with an incomplete college course had the shorter period of unemployment.

[16] No figure is shown in the table for engineers with a secondary-school education, for its significance is not certain. The median period for such engineers was 12.4 months.

The average length of the period of unemployment increased with age. Thus, the youngest group exposed to the full 5-year risk (those graduating in 1925 to 1929) had a median period of unemployment of 12.1 months. The next group of engineers, those graduating between 1915 and 1924, showed an increase of only 1.3 months in the period of unemployment. For those with an incomplete college course, who were 30 to 34 years of age in 1934, the average period of unemployment for the 5 years as a whole was 14.2 months and for those 35 to 39 years of age 14.6 months. Whether the differential for noncollegiate technical-school graduates of these ages is real, or is due to certain peculiarities of the sample, cannot be said; but for all professional classes of engineers there was also a slight increase in the average period of unemployment among those who graduated before 1925 as compared with those who graduated later. By and large, however, those engineers who were 30 to 40 years of age and became unemployed were unemployed for 12 to 14 months, but within these limits age was not an important factor.

It is interesting to note that the engineer who entered the profession during the period 1930–32 had an average period of unemployment which was almost identical with that shown for the engineers who had entered just prior to the depression. This was true, in spite of the fact that the younger men had a shorter period of exposure to unemployment; their lack of experience obviously militated against their absorption.

The severity of unemployment increased rapidly in the case of engineers who were more than 43 years of age in 1934. The median period of unemployment for those engineers 43 to 52 years of age who were unemployed was 17.8 months. Among the engineers 53 years of age and over it was 23.1 months. For the "other" engineers 40 years of age and over, the average period of unemployment was slightly more than 19 months as against about 14½ months for those who were 30 to 40. This rapid increase in the length of the average period of unemployment holds also with reference to all of the separate professional classifications. In the case of electrical engineers, the average rose from 14.1 months in the case of those who were 33 to 42 years of age to 25.3 months for those who were over 53 years of age. For mechanical and industrial engineers, the increase was from 15.2 to 22.2 months, and in the case of civil engineers from 12.9 to 22.9 months.

In general, therefore, it may be said that the average period of unemployment for graduate engineers tended to increase from about 1 year in the case of those who graduated from 1925 to 1929 to almost 2 years for those who graduated prior to 1905. The older engineer suffered from unemployment because of its greater length when it occurred rather than because of its greater frequency. Though the

proportion of those who became unemployed over the 5-year period was only two-thirds as great in the case of the oldest group as it was in the case of the youngest group to enter the profession prior to 1930, when unemployment did occur it tended to last twice as long in the case of the older engineer.

The averages for all graduate engineers without regard to age ranged from 9.8 months for chemical and ceramic engineers to 13.6 months for mining and metallurgical engineers. For the three largest classes the range was from 12.1 months in the case of mechanical and industrial engineers to 12.8 months for civil engineers. Those who graduated in 1933 to 1934 had an average period of unemployment of 6 to 8 months. Comparison of the severity of unemployment among the professional classes is confied to those four age groups that had entered the profession prior to 1930, for averages could not be shown for all age classes of chemical and ceramic engineers, as the number of those over 33 years of age was too small to allow of subdivision. It is apparent, however, that the average period of unemployment was not more than two-thirds as long for chemical and ceramic engineers as for the various other classes. The period of unemployment of mining and metallurgical engineers was probably somewhat shorter in the various age classifications than it was for the three larger professional classes.[17]

The general averages indicate comparatively little difference, as regards the period of unemployment, civil, electrical, and mechanical and industrial engineers.

Although unemployment occurred more frequently among civil engineers than in any other engineering class, its severity was slightly less than for the other classes.

The median periods of unemployment which have been cited show clearly enough the differences among the various groups. Long as these average periods were, they still fall short of conveying the full picture. This may be gathered from table 37, which shows the percentage of engineers who reported varying periods of unemployment. It covers only engineers with college degrees received in 1929 or earlier years, without regard to professional class. Of this group, 6,965 engineers reported that they were out of work at some time between January 1, 1930, and December 31, 1934. In slightly more than one-fifth of the cases, they were unemployed for less than 6 months; another fifth were out of work for from 6 months to a year. To a limited extent, those reporting unemployment of less than 6 months may have reported incidental and short periods between jobs. However, the median period of unemployment over these 5 years for

[17] It will be recalled that the average for all mining and metallurgical engineers was 13.6 months, higher than the average in any of the other professional classes. It appears from the detailed figures with reference to the periods of unemployment classified by age that in each age group the three larger professional classes showed either an equal severity or a greater severity.

those graduates who became unemployed was 14.7 months, and larger numbers were out of work for much longer periods. In fact, 800 engineers (11.5 percent of the total number becoming unemployed) of these particular graduating classes were out of work for 3 years or more.

TABLE 37.—*Percentage distribution of engineers graduating from college prior to 1930, by period of unemployment*

Year of graduation	Total reporting in survey	Total reporting unemployment at any time during 1930–34		Percentage whose reported unemployment (in months) was—								
		Number	Percentage	Under 6	6 and under 12	12 and under 18	18 and under 24	24 and under 30	30 and under 36	36 and under 42	42 and under 48	48 and over
All years prior to 1930	24,853	6,965	100.0	21.0	21.6	16.5	12.8	9.5	7.1	5.1	3.2	3.2
1925–29	6,499	2,340	100.0	23.9	25.7	19.4	13.4	7.9	4.0	3.2	1.6	.9
1915–24	8,298	2,245	100.0	23.3	22.9	16.1	11.4	9.4	7.3	4.4	3.0	2.2
1905–14	6,602	1,570	100.0	17.7	18.8	14.0	13.8	11.4	8.7	7.2	3.7	4.7
Prior to 1905	3,454	810	100.0	12.8	11.7	14.4	13.1	10.6	12.0	8.3	7.0	10.1

Unemployment of less than 6 months was reported by 23.9 percent of those graduating in the period 1925–29 who became unemployed, as against only 12.8 percent of those graduating prior to 1905. This tendency to shorter periods of unemployment among the younger graduates is equally marked among the group out of work for periods of 6 to 12 months. The percentages of the unemployed who were out for 18 to 24 months show no differences among the age groups, largely because this is a turning point in the distribution. In groups with the longer periods of unemployment the percentage for the older unemployed engineers is consistently higher than for the younger ones. Thus, at the extreme, only 0.9 percent of the unemployed engineers of the classes of 1925–29 were idle for 48 months or more, whereas 10.1 percent of those graduating prior to 1905 had more than a 4-year period of unemployment.

Influence of Regional Location on Unemployment

The data tabulated on a regional basis are given in table 38 for all first-degree engineering graduates (excluding those with postgraduate and nonengineering degrees) in the three professional classes of civil, electrical, and mechanical engineering.[18] There were too few cases to warrant regional tabulations for mining and metallurgical engineers and chemical and ceramic engineers; neither were tabulations justified in the case of engineers with various types of educational background

[18] Civil engineering as here tabulated does not include the few agricultural and architectural engineers reporting whose inclusion would have complicated the task without modifying the results. So also mechanical engineers do not include industrial engineers.

other than college graduations. Furthermore, in the regional [19] comparisons, work relief has been excluded, leaving only those periods during which the engineers reporting had no work of any sort; these periods have been termed "net unemployment."[20]

It will be noted in table 38 that the range for the three professional classes combined was from 20.7 percent in the District of Columbia to 37.9 percent in the East South Central region. For the country as a whole, approximately one out of every three of these college graduate engineers was unemployed at one time or another during the 5-year period.

TABLE 38.—*Net*[1] *unemployment, 1929 to 1934, among first-degree graduate engineers reporting, by region and professional class*

[Figures adjusted as explained on p. 34]

Professional class	Region										
	United States	District of Columbia	East South Central	Mountain	West South Central	South Atlantic	New England	West North Central	Pacific	East North Central	Middle Atlantic
	Percentage of first-degree graduates reporting net unemployment										
All three classes	33.2	20.7	37.9	34.2	29.4	30.9	32.8	29.8	29.1	33.3	37.1
Civil	35.6	18.1	41.3	31.6	29.7	33.5	36.3	30.9	28.9	36.8	45.2
Electrical	31.1	29.7	36.7	40.6	34.1	30.8	29.3	28.6	28.3	32.2	30.6
Mechanical	31.3	19.6	31.0	35.9	24.9	26.6	31.1	28.3	30.6	30.3	34.8
	Median period (in months) of net unemployment										
All three classes	11.3	7.9	9.3	10.7	9.4	10.4	11.7	10.2	11.1	12.2	12.1
Civil	11.2	8.4	9.0	9.9	8.7	10.3	12.0	9.5	11.1	12.0	12.8
Electrical	11.4	6.7	10.4	11.8	10.5	10.5	11.3	12.5	10.7	12.7	11.5
Mechanical	11.4	5.5	9.5	11.0	10.0	11.0	11.5	10.2	11.3	11.8	12.0

[1] Excludes direct relief and work relief.

In the various professional classes, unemployment occurred less frequently among engineers in the District of Columbia than among engineers reporting from other districts. Thus, 18.1 percent of the civil engineers in the District of Columbia had some unemployment during the 5 years, whereas in no other area did unemployment occur in less than 28.9 percent of the cases. For mechanical engineers, the District of Columbia reports showed 19.6 percent; the next lowest figure was 24.9 percent in the West South Central States. Only in

[19] It is necessary to assume that the region from which the engineers reported is the region to which the various items reported are to be allocated. This is a safe assumption as regards employment status as of December 31, 1934. Migration makes it less valid as regards status in 1929. The error is probably not so great as to warrant disregarding possible regional classification.

[20] The extent of the distortion introduced by this more limited definition of unemployment is not great enough to be serious. For engineers with degrees in the United States as a whole, 32.0 percent reported a period of net unemployment, while 33.9 percent reported a period of gross unemployment, a difference of only 1.9 percent. Further, the median period of gross unemployment (unemployment and work relief) was 12.2 months. The net period of unemployment (excluding any time reported on work relief) was 11.3 months.

the case of electrical engineers was unemployment among engineers in the District of Columbia approximately equal to that in other regions. In this profession 29.7 percent of those reporting from the District of Columbia had had some unemployment in the 5 years covered by the study.

Outside the District of Columbia there was also a rather marked range in the frequency of unemployment reported from the various regions in the several professional groups. Thus, in the case of civil engineers, the range was from 28.9 percent in the Pacific Coast States to 45.2 percent in the Middle Atlantic States, electrical engineers ranged from 28.3 percent in the Pacific region to 40.6 in the Mountain region, and, finally, mechanical engineers ranged from 24.9 percent in the West South Central region to 35.9 percent in the Mountain region.

The most significant fact is the great extent of unemployment among engineers in all geographical divisions. The regional differences in the rate of unemployment among the various classes of engineers are not sufficiently consistent to order all of the regions from high to low. The District of Columbia, as noted, had a consistently low percentage of unemployment. It may be noted further that engineers in each professional class reporting from the West North Central, the South Atlantic, and Pacific regions had a percentage of unemployment below the national average.

For the three professional classes combined, the range and the length of unemployment (disregarding period of work relief) was from 7.9 months in the District of Columbia to 12.2 months in the East North Central region (table 38).

Civil engineers showed unemployment ranging from 8.4 months in the District of Columbia to 12.8 months in the Middle Atlantic region; electrical engineers from 6.7 months in the District of Columbia to 10.4 months in the East South Central region, and to 12.7 months in the East North Central States. For mechanical engineers, the difference between the average of 5.5 months in the District of Columbia and that of 9.5 months in the East South Central States, the next lowest region, was especially great. The highest average for mechnical engineers was 12.0 months in the Middle Atlantic region.

The similarities in the lengths of the periods of net unemployment are more marked than any consistent series of differences among the regions. In general, the average period of net unemployment was longer in the Middle Atlantic, New England, and East North Central regions, whereas in the three Southern regions and the District of Columbia the average tended to be less than the general average for the country.

The regional analysis of the data relating to unemployment was undertaken originally to establish possible variations of a regional character. The differences shown for the individual professional

classes are large enough to deserve attention. If, for example, this had been a study of civil engineers alone, the spread in the incidence of net unemployment between 28.9 percent shown in the Pacific region and 45.2 percent shown in the Middle Atlantic States would have justified the regional break-down and must lead to the conclusion that there were pronounced regional differences. So, also, the span in the average period of net unemployment for civil engineers from 8.7 months in the West South Central area to 12.8 months in the Middle Atlantic States is a considerable one. These tables, as has been pointed out, do develop a few outstanding regional differences as regards the incidence and severity of unemployment for the three professional classes analyzed. They do not present a clear-cut picture of large regional differences for engineers in general. Geographical influences are certainly less consistent than those which have been shown with reference to type of engineering, age, and educational background.

The regional analysis has developed a confirmation of the national findings that is of importance. In any questionnaire study, there is always the possibility of an underlying selective bias that distinguishes the conditions of those who reply and those who fail to reply to the questionnaire. Even complete consistency in the results of successive analyses of small samples cannot establish the fact that no such bias exists. But the generalizations which have been drawn on the basis of national aggregates are substantially strengthened when it is found that they persist on a regional basis. Thus, as regards the median period of unemployment, we find that in at least five of the regions electrical engineers had a longer average period of net unemployment than either civil or mechanical engineers. In contrast to this, the averages for civil and mechanical engineers show negligible differences in four regions and differences of less than a month in two other regions.

The influence of age on the frequency and length of unemployment cannot be shown in the same detail on a regional basis as was possible on a national basis. Such age breakdowns, however, are possible for the three large professional classes in the East North Central and the Middle Atlantic States, the two regions with the largest number of reporting engineers.

As regards the frequency of unemployment (table 39) the pattern is almost without exception the same as that described on a national basis in greater detail. Unemployment was most frequent among the engineers who graduated in 1930–32 and was slightly less frequent for those who graduated in 1933–34 and had, therefore, only been in the professional market for a maximum period of 18 months. In both regions and in all three professional classes, unemployment occurred less frequently among engineers who graduated prior to 1925 than

among those who graduated in 1925–29. But even with these relatively small groups, at least one out of five was unemployed at one time or another within the 5-year period. This was the lowest ratio and occurred in the case of electrical engineers who graduated prior to 1925 and reported from the East North Central region.

As regards the median period of net unemployment, the average was consistently higher for the engineers who graduated prior to 1925 than it was for those who graduated between 1925 and 1929. It is also of interest to note the consistency as regards the period of unemployment for each age group shown for these three professional classes in the two regions.

TABLE 39.—*Net*[1] *unemployment, 1929 to 1934, among first-degree graduate engineers reporting, by region, age, and professional class*

[Figures adjusted as explained on p. 34]

Graduating class and age in 1934	East North Central region			Middle Atlantic region		
	Civil	Electrical	Mechanical	Civil	Electrical	Mechanical
	Percentage of first-degree graduates reporting net unemployment					
All graduating classes						
Entered profession in period 1930–34:						
1933–34 (23–24 years)	46.2	43.5	34.5	57.8	51.9	43.8
1930–32 (25–27 years)	58.9	52.3	45.5	64.8	48.1	45.6
Entered profession prior to 1930:						
1925–29 (28–32 years)	39.8	32.7	34.0	56.0	28.7	36.3
Prior to 1925 (33 years and over)	28.9	19.9	23.8	37.1	21.9	30.5
	Median period (in months) of net unemployment					
All graduating classes						
Entered profession in period 1930–34:						
1933–34 (23–24 years)	7.4	8.4	6.5	8.6	7.1	6.6
1930–32 (25–27 years)	11.6	14.0	10.7	12.3	13.6	11.4
Entered profession prior to 1930:						
1925–29 (28–32 years)	10.6	12.3	11.9	11.6	10.3	10.2
Prior to 1925 (33 years and over)	15.6	16.3	16.7	15.3	15.0	15.8

[1] Excludes direct relief and work relief.

Public Relief Among Professional Engineers, 1929 to 1934

Direct Relief [21]

Consideration of the number of engineers reporting direct relief evidences the fact that in the majority of cases engineers survived without public assistance their periods of unemployment from 1930 to 1934. This was especially true of those who entered the profession prior to 1930.

Thus, fewer than 1 percent of the engineers reported themselves to have been unemployed on December 31, 1929. At that time there

[21] The data for direct relief and work relief at end of 1929, 1932, and 1934 are presented in appendix E, pp. 224–228, tables 1 to 3, inclusive.

were no work-relief projects and none of the engineers reported themselves as on direct relief.[22] Slightly more than 10 percent of all engineers reported themselves as unemployed on December 31, 1932; 31 engineers reported themselves as on direct relief—less than one-tenth of 1 percent of all the engineers and only one-half of 1 percent of the number reporting unemployment.

For the 5-year period as a whole, receipt of some direct relief was reported by 0.8 percent of all engineers with college degrees and about 2 percent of those who attended noncollegiate technical schools or who did not complete their college course.[23]

Work Relief at End of 1929, 1932, and 1934

Engineering training was required in the administration of many of the projects designed to benefit other groups in the community. There was also a large increase in nonrelief forms of public employment. This was of particular benefit to civil engineers, of whom 8.5 percent were employed by the Federal Government on December 31, 1929, while 18.0 percent were so employed on December 31, 1934 For civil engineers the increase in this form of employment was greater than the increase in work relief.

Despite the increase in public employment, work-relief projects were the main source of assistance to those who were unemployed. On December 31, 1932, when slightly more than 10 percent of the engineers were unemployed, only 0.7 percent were on work relief. Two years later nearly 5 percent of all engineers were on work relief, which was approximately half of the total number of engineers unemployed at that time.

The reports for December 31, 1934, show striking differences in the extent of work relief as between civil engineers and the other professional groups. At that time 6.2 percent of all civil, agricultural, and architectural engineers were on work relief, as compared with only 2.2 percent of all the other professional classes combined. The difference probably reflects chiefly the development of work programs that called especially for the civil engineer's training; it also reflects the fact that the total amount of unemployment among civil engineers in their normal fields increased from 1932 to 1934, whereas it decreased in the other professional classes. The greater amount of work relief among civil engineers balanced their more widespread unemployment. There

[22] In this survey, work relief is defined as emergency employment, usually made available on the basis of need, by such agencies as C. W. A., F. E. R. A., and W. P. A. It does not include engineering work on P. W. A. projects, which should have been reported either as a form of private employment or as Government employment for those engineers working in the Public Works Administration itself. It also does not include engineers hired for strictly administrative work by the various relief administrations. There was some overreporting of work relief and a corresponding underreporting of public employment. Direct relief refers to direct financial or other assistance from any public authority.

[23] In New York City direct relief appears to have been more extensive through the Professional Engineers Committee on Unemployment than through public agencies.

was comparatively little difference between civil engineers and other professional groups as regards the net amount of unemployment on December 31, 1934; those entirely without work formed 4.0 percent of the civil engineers as compared with 5.1 percent of the other types combined.

Work relief was slightly more common among engineers without college degrees than among those who were college graduates. The situation with reference to direct relief has already been noted. Among the civil engineers 6.7 percent of the college graduates, as against 7.9 percent of the "other" engineers, were on work relief on December 31, 1934. For the 5 years as a whole, 16.8 percent of the graduate civil, agricultural, and architectural engineers group reported a work-relief experience, whereas 19.6 percent of this same group of professional classes with an incomplete college course so reported.[24]

Comparison of the proportions receiving work relief at the close of 1932 and 1934 indicates that the older engineers were favored prior to 1932, while the more recent graduates were being favored in 1934. In 1932 the group graduating in the period 1930–32 had a larger proportion of its membership unemployed than any of the other age classes, but the proportion of work relief (0.6 percent) was slightly less in December 1932 than the proportion among the older engineers (0.8 percent of those graduating from 1915–29 and 0.7 percent of those graduating prior to 1915). Among the civil, agricultural, and architectural engineers the difference in favor of the older groups was marked, work relief being reported for only 0.5 percent of those graduating from 1930 to 1932 as against 1.0 percent of those graduating from 1915 to 1929. By December 31, 1934, this situation had been reversed and there was a larger proportion on work relief among the recent college graduates than among those who had entered the profession prior to the depression. This was especially true of the civil engineers, for whom work relief on December 31, 1934, was reported for 9.4 percent of those graduating in 1933–34 and 8.3 percent of those graduating in 1930–32, in comparison to only 6.5 percent of those graduating in 1915–29 and 4.9 percent of those graduating prior to 1915. In the other professional groups no real differences between the early and late graduating classes appear. Of the engineers in professions other than the civil-engineering group, who graduated during the years 1930–32, 2.2 percent were on work relief, but 3.2 percent of those graduating in 1933–34 reported work relief. In this connection it must be recalled that in 1934 there was a larger proportion

[24] Separate figures are not available as regards the civil engineers who attended noncollegiate technical schools. Without regard to professional class, such engineers appear to have had a slightly lower work-relief experience than engineers with other types of educational background; 12.1 percent of all engineers from noncollegiate technical schools reported some period of work relief, whereas 14.0 percent of those with an incomplete college course and 12.4 percent of the college graduates so reported.

of unemployed among those graduating in 1933–34 than among the other age groups.

Work Relief, 1930 to 1934, Inclusive

Thus far, in this section, the discussion of work relief has been confined to the reports for specific dates. For the 5-year period as a whole, a larger number of engineers had some experience with work relief. For all types of engineers, irrespective of background, about one-eighth reported some period of work relief, but very wide differences were shown in the extent of work relief for civil engineers and for other types of engineers. Thus, among engineers with an incomplete college course, 19.6 percent of the civil-engineering group reported some work relief, whereas only 7.5 percent of those in the other professions considered together so reported. Among college graduates work relief was reported by 16.8 percent of the civil-engineering group and by only 10.9 percent of the mining and metallurgical engineers. For the other professional classes, the percentages were 8.3 for electrical engineers, 8.3 for mechanical and industrial engineers, and 6.6 for chemical and ceramic engineers.

In all professional classes, age was an important factor in the frequency of work relief. Table 40 gives for the three professional classes of civil engineers, electrical engineers, and mechanical engineers,[25] the percentages of those receiving work relief, at any time during the 5 years, 1930 to 1934, classified by age. The figures relate only to college graduates.

TABLE 40.—*Percentage of graduate engineers reporting work relief at any time, 1930 to 1934, by year of graduation and professional class*

[Figures adjusted as explained on p. 34]

Year of graduation	Percentage reporting work relief		
	Civil engineers	Electrical engineers	Mechanical engineers
All years	16.8	8.3	8.3
1933–34	26.4	12.5	10.2
1930–32	25.2	12.8	10.4
1915–29	15.9	6.2	7.4
Prior to 1915	12.4	6.3	7.6

It will be noted from the table that there was relatively little difference, as regards the frequency of work-relief experience between those graduating in 1930–32 and those graduating in 1933–34. Among civil engineers, approximately one-fourth of those in these classes reported a period of work relief, about an eighth of the electrical engineers, and slightly more than a tenth of the mechanical engineers. The percent-

[25] The civil engineers here tabulated do not include architectural and agricultural engineers, nor do the mechanical engineers include industrial.

age of civil engineers and electrical engineers who reported work relief was only half as large among those graduating prior to 1915 as among those graduating in 1930 or later years. Only for the civil engineers was there any indication of a difference in the frequency of work relief as between graduates of 1915–29 and those of years prior to 1915.

The median period of work relief was approximately 5 months, as shown in table 41 for college graduates classified by year of graduation in the three professional groups of civil, electrical, and mechanical engineering.

TABLE 41.—*Median period of work relief among graduate engineers, 1930 to 1934, by year of graduation and professional class*

[Figures adjusted as explained on p. 34]

Year of graduation	Median period (in months) of work relief		
	Civil engineers	Electrical engineers	Mechanical engineers
All years	5.2	4.5	5.1
1933–34	4.1	3.8	4.1
1930–32	4.8	4.3	4.5
1915–29	5.6	4.6	5.7
Prior to 1915	5.5	6.5	5.6

The differences in the length of the period between the various professional classes are small and show no particular regularity. Essentially, the periods are the same both for civil engineers and for mechanical engineers, though the average period was perhaps somewhat shorter in the case of electrical engineers. Little difference is shown between those who graduated from 1915–29 and those who graduated prior to 1915, but apparently those who graduated prior to 1930 had a slightly longer period of work relief than those who graduated in 1930–32.[26]

Thus far in this discussion, those reporting work relief have been regarded as unemployed. In more than four-fifths of the cases those who reported a period of work relief also reported a period of unemployment. However, of the 3,816 engineers with college degrees who reported a period of work relief, 642 reported no period of unemployment. This situation calls for some explanation though it does not change the general outline of the conclusions reached. There seems to be a slight overreporting of work relief and, therefore, a slight overestimate of unemployment due to the method of adding together periods of unemployment without work of any kind and periods of

[26] If it is correct to conclude that the major part of the work-relief experience came in the years 1933–34; the differences between the classes graduating in 1930–32 and those graduating earlier are not to be explained in terms of a longer period of eligibility for work relief. It may be pointed out that a shorter period in the case of the classes of 1930–32 is consistent with the earlier conclusion that recruitment was more extensive among this group of engineers than among the older ones. The still shorter period, which is indicated for those who graduated in 1933–34, may well be explained by the fact that they had a shorter period of eligibility for work relief.

work relief to determine the gross frequency and period of unemployment. There is also a corresponding underreporting of nonrelief public employment. In this discussion, it is necessary to distinguish three age groups, those graduating in 1929 or earlier years, those graduating in 1930–32, and those graduating in 1933–34. Among the more recent graduates little difference is found between civil engineers and all other types of engineers, as regards work relief without unemployment. Of the 533 engineers graduating from college in 1933–34 and reporting some work relief, 157 reported no period of unemployment, i. e., approximately a third of them appear to have entered directly into work relief. Among those graduating in 1930–32, 133 out of 819 or somewhat under a sixth, reported such an experience. This may merely reflect a need for young engineers to staff minor supervisory positions on projects conceived to meet the needs of other groups.

TABLE 42.—*Comparison of graduate engineers reporting work relief following unemployment, and of graduate engineers reporting work relief with no unemployment, 1930 to 1934*

[Figures adjusted as explained on p. 34]

Graduating class	Total number reporting work relief only, and work relief following unemployment			Total number reporting work relief only		
	All professional classes	Civil, agricultural, and architectural	All other professional classes	All professional classes	Civil, agricultural, and architectural	All other professional classes
All engineers with college degrees	3,816	2,170	1,646	642	390	252
Graduating classes:						
1933–34	533	269	264	157	83	74
1930–32	819	425	394	133	65	68
Prior to 1930	2,464	1,476	988	352	242	110

In the case of those civil engineers who graduated in 1929 or earlier years, 242 of the 1,476 who reported work relief did not report a period of unemployment. There are too few cases in the other professional classes to warrant a breakdown, but among all engineers other than civil engineers graduating in 1929 or earlier years, there were 110 out of 988 who reported no period of unemployment. Two factors lead to the belief that some of those reporting a period of work relief but no period of unemployment should be separated from the unemployed: (1) It will be noted that this situation was commoner among civil engineers than among the other professional classes, undoubtedly because the training of civil engineers was more extensively required on work-relief projects than was the training of other types of engineer; (2) it seems probable that there was some misunderstanding by engineers replying to the questionnaire and that a small percentage of them reported public administrative employment in

connection with work-relief projects as work relief rather than as public employment. It is possible that certain engineers reporting a period of work relief neglected to report a period of unemployment or merged the two figures in a single one of a period of work relief.

In general, a period of work relief was associated with a reported period of unemployment. This was true of more than 85 percent of the engineers, without regard to professional classification, graduated in 1929 or earlier years, who secured work relief. For this group of college graduates, there is a clear relationship between the period of unemployment and entrance into work relief.[27] The percentages in table 43 represent the ratio of the total number of individuals receiving work relief after a given period of unemployment to the total number of unemployed persons who had at least as much as the shortest period of unemployment indicated. Thus, for example, 6 percent of all civil engineers who reported any period of unemployment whatsoever were placed on work-relief projects after a period of less than 6 months of unemployment, 11.9 percent of all civil engineers who were unemployed 6 months or more were placed on work-relief projects after 6 to 12 months of unemployment, etc. The figures in the table relate only to unemployed engineers with college degrees who reported work relief at any time from January 1930 to December 1934.

TABLE 43.—*Percentage of unemployed graduate engineers on work relief after specified unemployment, 1930 to 1934, by year of graduation*

Year of graduation	Percentage of engineers who received work relief after specified months of unemployment							
	Less than 6	6–12	12–18	18–24	24–30	30–36	36–42	42–48
All engineers with college degrees	4.3	9.3	12.6	13.7	14.9	18.4	18.0	18.8
Civil engineers	6.0	11.9	15.7	17.9	18.1	22.1	21.2	24.6
1925–29	6.3	13.8	17.4	25.8	25.2	26.0	33.0	63.0
1915–24	7.2	13.5	19.5	20.9	19.8	36.0	28.0	27.0
1905–14	5.9	11.0	14.4	16.6	19.0	15.6	22.0	23.0
Prior to 1905	1.8	6.4	9.0	8.5	10.6	16.8	13.0	18.0
Other professional classes	2.8	7.0	9.9	10.2	12.5	15.5	15.5	14.1
1925–29	2.5	7.4	10.6	11.2	13.5	19.6	20.0	20.0
1915–24	3.7	7.5	12.4	12.7	11.8	19.3	20.0	8.0
1905–14	2.8	7.1	8.5	9.1	15.2	14.0	10.0	19.0
Prior to 1905	.8	4.5	5.4	5.9	8.4	9.7	14.0	12.0

[27] For the correlation of the period of unemployment that antedates relief, the following information is available: The total period of unemployment, exclusive of work relief, and the total period of work relief. In order to simplify the presentation, the material is presented as though there were in all cases a sequence of an unbroken period of unemployment followed in certain instances by work relief. It is quite possible that in certain instances the total period of unemployment is broken into several stretches interspersed with periods of work relief. In such a case, it would be incorrect to say that work relief followed after 12 months of unemployment if 12 months were the total reported period of unemployment exclusive of work relief. To distinguish several periods of unemployment would have required a greater refinement than it was possible to undertake by the questionnaire method. The extent of the error, which is implied in this assumption, is probably not great, but technically all that can be shown is a relationship between a certain aggregate period of unemployment, exclusive of work relief, and the existence of some period of work relief which may have preceded a period of unemployment or have broken into a period of unemployment.

During the 5-year period, placement on work-relief projects rose steadily as the period of unemployment was lengthened. For all unemployed civil engineers, the increase was from a 6.0-percent placement within less than 6 months to a 22.1-percent placement after 30 to 36 months of unemployment for those who had been unemployed as much as 30 months. Among the other professional groups, the corresponding percentages of placement rise from 2.8 to 15.5 percent, as would be expected, because of the larger number of cases covered. This movement is more regular for all classes of graduates combined than for the four age groups, but even in these age groups there is an essential regularity.

This increase in the percentage of placements on work-relief projects with lengthening periods of unemployment reflects the actual course of events in these 5 years, but the 5 years were not a homogeneous period as regards the availability of work relief, which was first inaugurated on a large scale in 1933. Any person unemployed for as little as 6 months in 1931 had virtually no opportunity to secure work relief. On the other hand, a person who became unemployed in July 1931 would, probably after the lapse of 30 months, have found C. W. A. work. Therefore, in interpreting the figures shown in the table, it must be remembered that longer periods of unemployment increased the probability of work relief merely by carrying over into a period in which work relief became available.

A further and more significant comparison may be made with reference to the availability of work relief to the members of the different groups of graduating classes. For this purpose, these classes should be interpreted as indicating not particularly differences between younger and older engineers, but more especially probable differences in the financial resources of the different groups. In the aggregate, those engineers who graduated prior to 1905 probably had substantially larger financial reserves than those who graduated from 1925 to 1929. In the case of civil engineers, the percentage on work relief was highest in the case of those who graduated from 1925 to 1929. Among the other professional groups, this relationship was less well maintained, though there appeared to be a distinct demarcation between those who graduated prior to and after 1915. The strongest contrast was between those who graduated in the period 1925–29 and those who graduated prior to 1905. Thus, 6.3 percent of the civil engineers who graduated from 1925 to 1929 received work relief after a period of less than 6 months of unemployment, but only 1.8 percent of those who graduated prior to 1905 reported work relief after such a period. Of the civil engineers unemployed as long as 24 months, 25.2 percent of those graduated in 1925–29, as contrasted with only 10.6 percent of those graduated prior to 1905, received work relief after 24 to 30 months of unemployment.

Chapter VII

Patent Privileges of Professional Engineers

Since definitive information on the subject of patent rights of professional workers has hitherto been unavailable, there were included in this survey certain questions relating to this subject. The particular information presented in this chapter covers the right to patent or to receive special compensation for inventions or improvements made on the one hand in the course of the work and on the other not directly related to the work in which the professional engineer was engaged. They are compiled from reports of those engineers who stated that they were engaged in engineering work in December 1934.

Patent Privileges by Field of Engineering Activity

Information as to patent privileges was furnished by 61.6 percent of the 35,559 reporting engineers [1] with engineering jobs at the end of 1934 (table 44).

Of all engineers covered, 31.7 percent reported retention of the patent rights for all inventions made either in the course of their work or in fields not directly related to their work. Among the nine separate fields of engineering activity this was true of the largest group in each case, except in manufacturing, where the highest proportion (30.1 percent) reported that they had no rights to patents relating to their work, but did retain their rights to those not directly related to their work. This latter combination ("(1) No, (2) Yes," in table 44) ranked second in importance and included 16.9 percent of the 35,559 engineers. The third group in importance (including 4,575, or 12.9 percent) was that reporting complete restriction on both aspects of patent privileges.

There were substantial variations in the rights to inventions in the several fields of employment. Thus, half of the engineers employed by manufacturing establishments reported that they had no rights in inventions made in the course of work and less than one-quarter reported positively that they did have special rights in connection with such inventions. One-third of those in extractive industries reported that they had no rights in such inventions, while an approxi-

[1] As in the case of the discussion of "Conditions of Employment" (ch. V, p. 81), the figures presented are unadjusted, as spot checks on an adjusted basis revealed no significant differences which would materially affect any conclusions derived from the analysis.

mately equal number reported they did have such rights. In various lines of private employment, the smallest proportion reporting no rights to inventions made in the course of work was found in construction, but the highest proportion positively reporting that they had special rights was in public utilities. Restrictions on rights in inventions made in the course of work existed for one-quarter of those engineers employed by the Federal Government, though more than half did not answer the question and only one-fifth stated positively that they did have special rights. In other fields of public employment and in personal service about 15 percent stated that they had no rights, while one-half of those in personal service, largely teachers, reported that they did have rights to inventions made in the course of work.

TABLE 44.—*Distribution of all engineers reporting patent rights at end of 1934, by field of engineering activity*

Field of engineering activity	Right retained to inventions (1) made in the course of work, and (2) not directly related to work					
	Total	(1) Yes; (2) yes	(1) No; (2) yes	(1) No; (2) no	(1) Yes; (2) no	Not reporting
	Number					
All fields	35,559	11,263	6,017	4,575	42	[1] 13,662
Private engineering	21,604	6,499	4,801	3,279	29	6,996
Construction	3,437	1,178	294	405	5	1,555
Extractive industries	1,841	601	342	288	2	608
Public utilities	4,183	1,771	670	374	6	1,362
Transportation	1,255	434	217	143	3	458
Manufacturing	10,888	2,515	3,278	2,069	13	3,013
Public engineering	11,177	3,364	946	1,150	10	5,707
Federal Government	4,649	1,009	582	567	3	2,488
State and county governments	4,438	1,587	249	386	5	2,211
Municipal governments	2,090	768	115	197	2	1,008
Personal service	2,778	1,400	270	146	3	959
	Percentage					
All fields	100.0	31.7	16.9	12.9	0.1	38.4
Private engineering	100.0	30.1	22.2	15.2	.1	32.4
Construction	100.0	34.3	8.6	11.8	.1	45.2
Extractive industries	100.0	32.6	18.6	15.6	.1	33.1
Public utilities	100.0	42.4	16.0	8.9	.1	32.6
Transportation	100.0	34.6	17.3	11.4	.2	36.5
Manufacturing	100.0	23.1	30.1	19.0	.1	27.7
Public engineering	100.0	30.1	8.5	10.3	.1	51.0
Federal Governments	100.0	21.7	12.5	12.2	.1	53.5
State and county governments	100.0	35.8	5.6	8.7	.1	49.8
Municipal governments	100.0	36.7	5.5	9.4	.1	48.3
Personal service	100.0	50.4	9.7	5.3	.1	34.5

[1] Included in this total are 42 cases in which reports state that there is a right to inventions made in the course of work but no rights to inventions not connected with the work, a combination which suggests error in reporting. It affects 0.1 percent in each class in table 44 (except transportation, 0.2).

As a general rule in all fields of engineering activity, rights to inventions made outside the course of work were retained by engineers. This was specially stated to be so by more than half the engineers in the

several fields of private employment, except construction where 45.2 percent failed to answer the question. On the other hand, specific answers that such rights did not exist were made by 19.0 percent of those employed in manufacturing and 15.6 percent of those in extractive industries. Only about half of those engaged in public service answered the question. Of those who did answer, four times as many said they had rights to inventions made outside the course of work as said they did not have rights to such inventions. Even in this field approximately one-tenth did not have special rights in inventions made outside the course of work.

Patent Privileges by Type of Engineering Work

Of the engineers who were engaged in engineering work in December 1934, 34,101 reported on the type of engineering work in which they were engaged. This is a somewhat smaller number than reported on the field of employment. In general, of course, the same distribution is shown as regards patent rights in table 45, where the classification is by type of work, as was shown in table 44 for field of employment.

There were distinct differences as regards rights in inventions among the several types of professional work. Teachers had the most extensive rights in inventions, and engineers engaged in sales and in design and research were most restricted.

TABLE 45.—*Distribution of all engineers reporting patent rights at end of 1934, by type of engineering work*

Type of engineering work	Right retained to inventions (1) made in the course of work, and (2) not directly related to work				
	Total	(1) Yes; (2) yes	(1) No; (2) yes	(1) No; (2) no	Not reporting
	Number				
All types	34,101	10,828	5,779	4,401	[1] 13,093
Design and research	9,050	2,128	2,404	1,430	3,088
Construction	8,233	2,730	717	892	3,894
Operation	8,276	2,737	1,494	1,108	2,937
Consulting	2,146	695	202	246	1,003
Teaching	2,050	1,132	199	90	629
Sales	1,513	453	310	293	457
General administration and management	2,833	953	453	342	1,085
	Percentage				
All types	100.0	31.8	16.9	12.9	38.4
Design and research	100.0	23.5	26.6	15.8	34.1
Construction	100.0	33.2	8.7	10.8	47.3
Operation	100.0	33.1	18.1	13.4	35.4
Consulting	100.0	32.4	9.4	11.5	46.7
Teaching	100.0	55.3	9.7	4.4	30.6
Sales	100.0	29.9	20.5	19.4	30.2
General administration and management	100.0	33.6	16.0	12.1	38.4

[1] Included in this total are 40 cases in which reports state that there is a right to inventions made in the course of work but no rights to inventions not connected with the work, a combination which suggests error in reporting. It affects not more than 0.1 percent in each type of work shown in the table.

In general, about one-third of the engineers stated positively that they retained rights in inventions made in the course of their employment. But 55.3 percent of the teachers stated that they had such rights, while only 14.1 percent of them reported that they had no such rights. In construction and consulting work, approximately one-third reported that they had rights in such inventions and one-fifth that they had no such rights. Engineers engaged in operation and in general administration reported about as frequently that they did have rights to inventions made in the course of work as that they did not. However, among engineers engaged in sales, and in design and research, approximately two-fifths stated positively that they did not have rights in inventions made in the course of work, while a very much smaller proportion (in the case of those engaged in design and research, less than one-fourth) reported positively that they had rights to inventions made in the course of work.

The same general relationship as regards the restriction on rights in inventions holds with reference to inventions not directly related to the work on which engineers were employed. In the case of teachers, almost two-thirds stated positively that they had rights in such inventions and only 4.4 percent reported that they did not have such rights. Among the other groups, approximately half had rights in inventions not made in the course of work. About one-eighth stated that they did not have rights in inventions even though they were not directly related to the work in which they were employed. In this respect, there appeared to be no substantial differences in practice affecting engineers engaged in construction, operation, consultation, or general administration. The differences shown in the table probably arise from differences in the percentage which did not answer this question. But in the case of engineers engaged in design and research, 15.8 percent reported positively that they had no rights to inventions not directly related to work. Engineers engaged in sales reported a restriction in this respect in 19.4 percent of the cases.

Chapter VIII

Earned Annual Incomes of Professional Engineers, 1929 to 1934

The annual incomes reported in this survey include those received by engineers from all personal services in the three years 1929, 1932, and 1934. They are a measure of what engineers were able to earn and were determined, not only by the rate of earnings, but also by the volume of employment. In the first part of this chapter, the earned annual income data are presented without regard to their source, that is, they relate to the incomes of engineers, not to the incomes of men engaged primarily in engineering or nonengineering work. These particular data are shown in relation to (1) professional class, (2) age, and (3) type of education.

In part II, however, the annual incomes, classified by age only, are shown related to the professional engineer's employment status. The employment status, it will be recalled, was reported only as of December 31, 1929, 1932, and 1934. Consequently, it has been necessary to assume that the kind of engineering or nonengineering employment engaged in at the end of the year was the source of the income for that year. This assumption makes possible valid general comparisons of the earnings of engineers in these two types of employment. But in the section dealing with the annual incomes of engineers who were unemployed, or who were employed on relief projects at the end of the year, it must not be assumed that they reflect the source of the income. They are merely the incomes which had accrued during the year to those who were unemployed at the end of the year.

Salient Features of the Data [1]

From a consideration of certain pertinent aspects affecting the returns on income and earnings for 1929, 1932, and 1934, it is believed that these data are representative of the engineering profession as a whole. They have been shown to be representative as regards age, after allowance is made for the larger representation of engineers graduating in 1930 or later years. Also the several distributions of income follow a consistent pattern even when analyzed in detail.

[1] To avoid an obvious repetition it is to be noted that the remarks in this section apply to both earned annual incomes as discussed in this chapter and to the analysis of monthly rates of compensation from engineering work only, presented in the chapter immediately following.

Thus, the same type of distribution emerges when the data are analyzed by ages, by professional classes, or even on a regional basis. This is true of both annual income and monthly engineering income.

TABLE 46.—*Comparison of gross and net numbers of engineers reporting annual earnings in 1934*

[Without regard to employment status reported]

Professional class	Graduates of classes				"Other" engineers born			
	Total	Prior to 1930 [1]	1930–32	1933–34	Total	Prior to 1907 [1]	1907–9	1910–14
	Number							
All classes:								
Number reporting in survey	43,288	24,826	11,050	7,412	9,301	8,440	575	286
Gross number reporting income	38,513	22,178	10,201	6,134	8,277	7,513	523	241
Net number reporting income	33,720	20,376	7,210	6,134	7,569	6,871	457	241
Chemical and ceramic:								
Number reporting in survey	3,697	1,451	1,259	987	203	158	27	18
Gross number reporting income	3,270	1,285	1,169	816	177	137	27	13
Net number reporting income	2,749	1,150	783	816	156	124	19	13
Civil, agricultural, and architectural:								
Number reporting in survey	16,114	10,314	3,602	2,198	4,712	4,341	256	115
Gross number reporting income	14,562	9,344	3,369	1,849	4,275	3,941	233	101
Net number reporting income	12,984	8,596	2,539	1,849	3,915	3,603	211	101
Electrical:								
Number reporting in survey	9,924	5,182	2,949	1,793	1,519	1,285	156	78
Gross number reporting income	8,792	4,688	2,686	1,418	1,345	1,140	140	65
Net number reporting income	7,627	4,368	1,841	1,418	1,256	1,067	124	65
Mechanical and industrial:								
Number reporting in survey	11,643	6,596	2,854	2,193	2,590	2,407	124	59
Gross number reporting income	10,236	5,785	2,620	1,831	2,246	2,082	113	51
Net number reporting income	8,923	5,271	1,821	1,831	2,035	1,889	95	51
Mining and metallurgical:								
Number reporting in survey	1,910	1,283	386	241	277	249	12	16
Gross number reporting income	1,653	1,076	357	220	234	213	10	11
Net number reporting income	1,437	991	226	220	207	188	8	11
	Percentage of number reporting in survey							
All classes:								
Gross number reporting income	89.0	89.3	92.4	82.8	89.0	89.0	91.0	84.3
Net number reporting income	77.9	82.0	65.3	82.8	81.4	81.4	79.5	84.3
Chemical and ceramic:								
Gross number reporting income	88.5	88.4	93.0	82.7	87.2	86.7	100.0	72.2
Net number reporting income	74.4	79.1	62.3	82.7	76.8	78.5	70.4	72.2
Civil, agricultural, and architectural:								
Gross number reporting income	90.4	90.6	93.6	84.1	90.7	90.8	91.0	87.8
Net number reporting income	80.6	83.3	70.6	84.1	83.1	83.0	82.4	87.8
Electrical:								
Gross number reporting income	88.6	90.4	91.1	79.1	88.5	88.7	89.7	83.3
Net number reporting income	76.9	84.3	62.5	79.1	82.7	83.0	79.5	83.3
Mechanical and industrial:								
Gross number reporting income	87.9	87.7	91.9	83.5	86.7	86.5	91.1	86.4
Net number reporting income	76.6	79.9	63.9	83.5	78.6	78.5	76.6	86.4
Mining and metallurgical:								
Gross number reporting income	86.5	83.9	92.5	91.3	84.5	85.5	83.3	68.8
Net number reporting income	75.2	77.2	58.5	91.3	74.7	75.5	66.7	68.8

[1] Includes all engineers 23 years of age and more in 1929 who reported they were profesionally active prior to 1930.

Furthermore, the averages proved to be essentially the same, whether derived from a "gross" or "net" number reporting. The "gross" number reporting income is the total number of engineers who reported income in any 1 year, irrespective of whether or not they reported in other years. The "net" number reporting income is the number who furnished information for all three years—1929,

1932, and 1934.[2] In the income tables averages are derived from the "gross" numbers reporting.

TABLE 47.—*Comparison of gross and net numbers of engineers reporting monthly engineering earnings [1] in 1934*

[Without regard to employment status reported]

Professional class	Graduates of classes				"Other" engineers born			
	Total	Prior to 1930 [2]	1930–32	1933–34	Total	Prior to 1907 [2]	1907–9	1910–14
	Number							
All classes:								
Number reporting in survey	43,288	24,826	11,054	7,412	9,301	8,440	575	286
Gross number reporting income	31,574	19,814	7,405	4,355	7,504	6,860	447	197
Net number reporting income	26,680	17,686	4,639	4,355	6,639	6,070	372	197
Chemical and ceramic:								
Number reporting in survey	3,697	1,451	1,259	987	203	158	27	18
Gross number reporting income	2,568	1,151	842	575	141	116	16	9
Net number reporting income	2,071	1,004	492	575	118	99	10	9
Civil, agricultural, and architectural:								
Number reporting in survey	16,114	10,314	3,602	2,198	4,712	4,341	256	115
Gross number reporting income	12,929	8,593	2,817	1,519	3,996	3,691	212	93
Net number reporting income	11,073	7,647	1,907	1,519	3,538	3,260	185	93
Electrical:								
Number reporting in survey	9,924	5,182	2,949	1,793	1,519	1,285	156	78
Gross number reporting income	6,307	4,003	1,524	780	1,138	980	109	49
Net number reporting income	5,376	3,678	918	780	1,041	898	94	49
Mechanical and industrial:								
Number reporting in survey	11,643	6,596	2,854	2,193	2,590	2,407	124	59
Gross number reporting income	8,350	5,105	1,938	1,307	2,022	1,882	102	38
Net number reporting income	6,994	4,511	1,176	1,307	1,765	1,648	79	38
Mining and metallurgical:								
Number reporting in survey	1,910	1,283	386	241	277	249	12	16
Gross number reporting income	1,420	962	284	174	207	191	8	8
Net number reporting income	1,166	846	146	174	177	165	4	8
	Percentage of number reporting in survey							
All classes:								
Gross number reporting income	72.9	79.8	67.1	58.8	80.7	81.3	77.7	68.9
Net number reporting income	61.6	71.2	42.0	58.8	71.4	71.9	64.7	68.9
Chemical and ceramic:								
Gross number reporting income	69.5	79.2	67.0	58.3	69.5	73.4	59.3	50.0
Net number reporting income	56.0	69.1	39.1	58.3	58.1	62.7	37.0	50.0
Civil, agricultural, and architectural:								
Gross number reporting income	80.2	83.3	78.3	69.1	84.8	85.0	82.8	80.9
Net number reporting income	68.7	74.1	53.0	69.1	75.1	75.1	72.3	80.9
Electrical:								
Gross number reporting income	63.6	77.2	51.7	43.5	74.9	76.3	69.9	62.8
Net number reporting income	54.2	70.9	31.2	43.5	68.5	69.9	60.3	62.8
Mechanical and industrial:								
Gross number reporting income	71.7	77.4	68.0	59.6	78.1	78.2	82.3	64.4
Net number reporting income	60.1	68.4	41.2	59.6	68.1	68.5	63.7	64.4
Mining and metallurgical:								
Gross number reporting income	74.3	75.0	73.6	72.2	74.7	76.7	66.7	50.0
Net number reporting income	61.0	65.9	37.8	72.2	63.9	66.3	33.3	50.0

[1] In the text, "engineering earnings," "monthly engineering income," and "engineering income," are used interchangeably.

[2] Includes all engineers 23 years of age and more in 1929 who reported they were professionally active prior to 1930.

[3] In the case of the 1930–32 graduates and "other" engineers born in 1907–9, the net number reporting income is the number furnishing data for the 2 years 1932 and 1934. In the case of the 1933–34 graduates and 1910–14 "other" engineers, income data for 1934 alone were relevant. Hence, there is no difference between "gross" and "net" data.

The "gross" numbers reporting earned annual income for 1934 and the "net" numbers are shown compared in table 46. These numbers are the totals of those returning questionnaires before any adjustment was made in the number of the younger men.

In each case, the base for computing percentages was the number reporting in the survey, that is, those engineers who reported a type of education.[3] For all age groups, it will be noted that there were distinct differences between the "gross" and "net" percentages reporting income. The greatest divergences occurred among the 1930–32 graduate and the 1907–9 "other" engineers. For the country as a whole, these were, respectively, 27.1 and 11.5 percent. On a national basis, older graduates differed by 7.3 percent, older "other" engineers by 7.6 percent. Despite these variations, a comparison of the corresponding measures of levels of annual income derived from the "gross" and "net" returns showed no significant differences. A similar situation was noted for the "gross" and "net" returns on monthly engineering income shown in table 47.

In the ensuing discussion, the middle values of income were computed for groups with at least 10 engineers reporting. For the upper and lower 25-percent groups or levels, the measures were based on not less than 50, while the upper and lower 10-percent groups embraced not less than 100 engineers.

Earned Annual Incomes From All Sources in 1929, 1932, and 1934

Incomes of All Engineers Combined Without Regard to Age

The income data for 1929 were furnished by 30,032 engineers, or slightly over 90 percent of all reporting engineers who were 23 years of age and more in 1929 and who reported that they were professionally active prior to 1930.[4] These data, together with the adjusted figures on earned annual income, without regard to employment status reported, for 1932 and 1934, are shown in table 48.

[3] The use of type of education as a base was felt to be justified because only 104 of the 52,589 professional engineers reporting in this survey did not report their type of education. The 104 engineers, however, did report their professional class, and either year of graduation or year of birth. They were, therefore, used for all purposes, except those dealing with type of education.

[4] The gross figure of 38,513 shown in table 46 relates to all reports, whether for engineers in the profession in 1929 or to recent entrants.

The choice of 23 years of age as datum arises from the fact that this was the computed median age of graduation of graduate engineers. It is obvious that this base did not make it feasible to include in the 1929 tabulations those "other" engineers who were under 23 years of age in 1929. Their data, however, are shown compared with those reported by the 1930–32 graduates, that is, men of comparable ages for the years 1932 and 1934.

TABLE 48.—*Comparison of 5 levels of annual earning in 1929, 1932, and 1934 of all professional engineers reporting*

[Figures adjusted as explained on p. 34 and without regard to employment status reported or type of education]

Percentage at specified income level	Annual earnings of more than specified amount			Increase or decrease			Percentage change		
	1929	1932	1934	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34
10 percent	$7,466	$5,605	$5,138	−$2,328	−$1,861	−$467	−31.2	−24.9	−8.3
25 percent	5,012	3,827	3,429	−1,583	−1,185	−398	−31.6	−23.6	−10.4
50 percent	3,412	2,574	2,286	−1,126	−838	−288	−33.0	−24.6	−11.2
75 percent	2,509	1,698	1,473	−1,036	−811	−225	−41.3	−32.3	−13.3
90 percent	1,878	889	872	−1,006	−989	−17	−53.6	−52.7	−1.9

In 1929 the range in earned annual incomes among professional engineers was great. Some 479 reported incomes less than $800 per year, while 295 earned more than $19,000 a year. In 1929, without regard to their age distribution, half of the engineers had annual incomes greater than $3,412, while half earned less than that figure. However, 25 percent earned more than $5,012 per annum. Only 10 percent of the 30,032 reporting engineers had incomes in excess of $7,466 per annum. On the other hand one-quarter of all engineers reporting earned less than $2,509 per year, and one-tenth earned less than $1,878 per year.

From 1929 to 1934, marked decreases took place in the earned annual incomes of professional engineers. The sharpest absolute declines occurred in the higher income levels. Thus, in 1929, while the highest one-tenth of the engineers had earned more than $7,466, in 1934 the earnings of this highest-paid tenth ranged down to $5,138. The middle income declined from $3,412 in 1929 to $2,286 in 1934. However, the percentages of decrease for the highest 10 and 25 percent of reporting engineers were approximately the same, namely, 31.2 and 31.6 percent, respectively. The middle or average values of all incomes declined by 33.0 percent. At the lower income levels, the absolute declines were almost as great as was the decline of the median earnings; but the percentage decreases were greater. This decrease at the lower levels reflects not only salary cuts, but also the low earnings of those with long periods of unemployment. In 1929, while the yearly earnings reported by the lowest 25 and 10 percent of the engineers were less than $2,509 and $1,878 respectively, by 1934 the former had decreased to $1,473, the latter to $872. The relative percentage decreases were greatest for these two lower income levels, namely, 41.3 and 53.6.[5]

[5] It must be noted that errors of reporting account for part of the decline, at least in the lowest brackets for which comparison is made. The questionnaire called for earnings during the calendar years 1929 and 1934. An engineer graduating from college in either year would usually have had only a half year in which he earned. In both years, there is some evidence that annual rates were occasionally reported. Such overreporting was more common for 1929 than 1934.

Almost two-thirds of the decrease in earned annual incomes occurred between 1929 and 1932. This, it will be recalled, was coincident with the greatest declines in employment. There were further declines in the period 1932 to 1934. In general, the order of the absolute decreases and the percentages of change followed those which took place in the period 1929 to 1934, the one exception being that, between 1932 and 1934, there was only a 1.9 percent decline in the lowest income levels. The corresponding absolute decrease was $17.

Incomes by Professional Class, Without Regard to Age

When these adjusted data on annual income were compared for all engineers reporting in the five professional classes, marked divergences in their respective earnings capacities were revealed.

These differences in earnings capacities within the several professional classes were greatest at the higher income levels. Thus, in 1929, nine-tenths of all electrical engineers earned $1,662 or more, while a similar proportion of the mining and metallurgical engineers earned $1,985. The range was $323. For the middle values of income, a difference of $733 was noted between the extremes of $4,010 for mining and metallurgical and $3,277 for electrical engineers. On the other hand, at the highest level, one-tenth of the mining and metallugrical engineers earned $9,912 or more, whereas a corresponding proportion of civil engineers earned only $6,507 or more. Clearly, it was in the higher income levels that the earnings capacities of the several professional classes diverged the most, even in terms of percentages. Furthermore, this characteristic of greater variability among the professional classes at higher levels persisted in 1929, 1932, and 1934.

However, when the question is asked as to which professional class offers the greatest earnings, or which the lowest, the answer must be carefully qualified. In the first place, the averages shown in table 49 relate to the total number of the professional class. For example, 1,319 mining and metallurgical engineers reported incomes for 1929, and of these one-tenth, or 132, had incomes of $10,000 or more. There were 13,424 civil, agricultural, and architectural engineers, of whom one-tenth, or 1,342, had incomes in excess of $6,507. Therefore, it may be concluded that of every 1,000 engineers in either professional class, a larger proportion will earn $10,000 in mining and metallurgical engineering than in civil engineering. But the total number of opportunities to earn $10,000 were greater in civil engineering, much the larger of the two professional classes. Among the civil engineers reporting to the Bureau for 1929, there were 469 who indicated incomes of $10,000 or more in 1929.

TABLE 49.—*Comparison of 5 levels of annual earnings in 1929, 1932, and 1934 of all engineers reporting, by professional class*

[Figures adjusted as explained on p. 34 and without regard to employment status reported or type of education]

Percentage of professional class at specified income level [1]	Annual earnings of more than specified amount			Increase or decrease			Percentage change		
	1929	1932	1934	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34
10 percent:									
Mining and metallurgical	$9,912	$7,011	$6,486	−$3,426	−$2,901	−$525	−34.6	−29.3	−7.5
Chemical and ceramic	9,103	6,525	5,860	−3,243	−2,578	−665	−35.6	−28.3	−10.2
Mechanical and industrial	8,508	6,220	5,572	−2,936	−2,288	−648	−34.5	−26.9	−10.4
Electrical	7,185	5,785	5,220	−1,965	−1,400	−565	−27.3	−19.5	−9.8
Civil, agricultural, and architectural	6,507	5,086	4,561	−1,946	−1,421	−525	−29.9	−21.8	−10.3
25 percent:									
Mining and metallurgical	6,301	4,698	4,328	−1,973	−1,603	−370	−31.3	−25.4	−7.9
Chemical and ceramic	6,043	4,425	3,703	−2,340	−1,618	−722	−38.7	−26.8	−16.3
Mechanical and industrial	5,582	4,123	3,662	−1,920	−1,459	−461	−34.4	−26.1	−11.2
Electrical	4,806	3,770	3,410	−1,396	−1,036	−360	−29.0	−21.6	−9.5
Civil, agricultural, and architectural	4,508	3,579	3,266	−1,242	−929	−313	−27.6	−20.6	−8.7
50 percent:									
Mining and metallurgical	4,010	3,061	2,626	−1,384	−949	−435	−34.5	−23.7	−14.2
Chemical and ceramic	3,803	2,625	2,047	−1,756	−1,178	−578	−46.2	−31.0	−22.0
Mechanical and industrial	3,699	2,681	2,324	−1,375	−1,018	−357	−37.2	−27.5	−13.3
Civil, agricultural, and architectural	3,291	2,545	2,297	−994	−746	−248	−30.2	−22.7	−9.7
Electrical	3,277	2,509	2,218	−1,059	−768	−291	−32.3	−23.4	−11.6
75 percent:									
Mining and metallurgical	2,839	1,788	1,512	−1,327	−1,051	−276	−46.7	−37.0	−15.4
Mechanical and industrial	2,626	1,676	1,424	−1,202	−950	−252	−45.8	−36.2	−15.0
Chemical and ceramic	2,538	1,556	1,213	−1,325	−982	−343	−52.2	−38.7	−22.0
Civil, agricultural, and architectural	2,499	1,770	1,596	−903	−729	−174	−36.1	−29.2	−9.8
Electrical	2,339	1,634	1,343	−996	−705	−291	−42.6	−30.1	−17.8
90 percent:									
Mining and metallurgical	1,985	773	893	−1,092	−1,212	+120	−55.0	−61.1	+15.5
Mechanical and industrial	1,956	919	853	−1,103	−1,037	−66	−56.4	−53.0	−7.2
Civil, agricultural, and architectural	1,926	909	1,016	−910	−1,017	+107	−47.2	−52.8	+11.8
Chemical and ceramic	1,686	732	610	−1,076	−954	−122	−63.8	−56.6	−16.7
Electrical	1,662	873	731	−931	−789	−142	−56.0	−47.5	−16.3

[1] Arranged in ascending order of earned annual income for 1929.

Again, the ranking of the profession on the basis of earnings opportunity relative to the number of engineers in the professional class was not the same at all levels and in all three periods. As regards the relative level of income for the highest 10 percent, and also the highest 25 percent, in each professional class, there was a constant relationship. Thus, in 1929, 10 percent of the mining and metallurgical engineers earned more than $9,912. Chemical and ceramic engineers ranked second with 10 percent earning more than $9,103, and were followed in order by mechanical and industrial engineers ($8,508), electrical engineers ($7,185), and civil engineers ($6,507). Relative to the mining and metallurgical engineers, the divergence was 8, 14, 27, and 33 percent. A similar divergence was noted between the lower limit of $6,301 reported by the upper fourth of the mining and metallurgical engineers and those of the other professional classes. In 1929, these ranged from 4 percent in the case of chemical and ceramic ($6,034) to 28 percent for the civil engineers ($4,508). This order of professional classes was also maintained in 1932 and 1934.

In 1929, the relative order of the median professional incomes was the same as that just described, as regards mining, chemical, and mechanical engineers. But whereas the upper limit of the earnings of the lowest 25 percent of the electrical engineers exceeded that of a similar proportion of the civil engineers by 6.6 percent, at the median level the situation was reversed—half the civil engineers earned $3,291 or more, whereas half the electrical engineers earned $3,277 or more. This change in order persisted in 1932 and 1934.

In 1932 and 1934, the median earnings of mining and mechanical engineers led all the others. Chemical engineers were below mechanical engineers in 1932. The median earnings of chemical engineers were lower than the median of every other professional class in 1934.

At the lower levels the most marked shift in rank was that of civil engineers and chemical engineers. In 1929, one-quarter of the civil engineers earned less than $2,499, exceeding only the comparable earnings of electrical engineers. But in 1932, civil engineers were in second place as regards the level of earnings of the lowest quarter of the profession, and in 1934 they were in first place. Even in 1929, the lowest 10 percent of the civil engineers had earned almost as much as the lowest 10 percent of the mining and mechanical engineers, and substantially exceeded the level of the lowest 10 percent of the chemical and electrical engineers. With reference to both the lowest 25 and 10 percent groups, chemical engineers' earnings came in last place in 1932 and 1934.

Further examination of the adjusted data in table 49, given without regard to age, demonstrates not only differences in earnings capacities but also variations in the decreases in earned annual income over the period 1929 to 1934. Without exception, the greater part of all contractions in income reported occurred between 1929 and 1932, though there were further declines in the period 1932 and 1934.

Annual Income Related to Age—All Engineers Combined

The effects of age upon earned annual incomes, for all professional engineers combined are presented in table 50.

This table makes it plain that the engineers' earnings advanced with age. In 1929, the income level of half of the engineers who had graduated in 1927 or 1928, or were from 24 to 25 years of age, exceeded $2,098, whereas that of half of the engineers in the age group 56–63 exceeded $4,968. Similarly, in 1932 and 1934 there was a continuous advance. But apparently age 60 represented a turning point in the average earnings of professional engineers. Furthermore, the increase in earnings with age comprised three distinct phases: Initial periods of exceptionally rapid rise which contain the maximum average yearly increase, followed by two others in which the rates of increase were

TABLE 50.—*Comparison of 5 levels of annual earnings in 1929, 1932, and 1934 of all engineers reporting, by age*

[Without regard to employment status reported or type of education]

Age	Year of graduation	Years after graduation	Proportion with annual earnings of more than specified amount				
			10 per cent	25 per cent	50 per cent	75 per cent	90 per cent
			1929				
64 years and over	Prior to 1889	41 and over	$9,999	$6,942	$4,427	$3,005	$1,904
56–63 years	1889–96	33–40	12,749	7,493	4,968	3,378	2,328
48–55 years	1897–1904	25–32	11,701	7,129	4,918	3,471	2,621
40–47 years	1905–12	17–24	9,913	6,473	4,588	3,403	2,683
36–39 years	1913–16	13–16	7,936	5,802	4,121	3,210	2,563
32–35 years	1917–20	9–12	6,520	4,850	3,674	3,004	2,448
28–31 years	1921–24	5–8	4,797	3,786	3,145	2,567	2,130
26–27 years	1925–26	3–4	3,621	3,099	2,550	2,149	1,827
24–25 years	1927–28	1–2	3,049	2,497	2,098	1,822	1,462
23 years [1]	1929	0	2,330	1,922	1,313	882	478
			1932				
67 years and over	Prior to 1889	44 and over	$8,940	$5,931	$3,650	$2,104	$953
59–66 years	1889–96	36–43	9,318	6,167	3,959	2,462	964
51–58 years	1897–1904	28–35	8,350	5,753	3,832	2,525	1,219
43–50 years	1905–12	20–27	7,570	5,192	3,619	2,520	1,410
39–42 years	1913–16	16–19	6,395	4,592	3,385	2,475	1.478
35–38 years	1917–20	12–15	5,519	4,115	3,135	2,307	1,355
31–34 years	1921–24	8–11	4,287	3,386	2,677	2,025	1,229
29–30 years	1925–26	6–7	3,428	2,862	2,314	1,810	1,110
27–28 years	1927–28	4–5	2,970	2,452	2,020	1,504	876
26 years	1929	3	2,451	2,075	1,772	1,271	735
25 years	1930	2	2,139	1,898	1,540	1,007	577
24 years	1931	1	1,960	1,605	1,224	733	293
23 years [1]	1932	0	1,673	1,097	645	322	129
			1934				
69 years and over	Prior to 1889	46 and over	$7,360	$5,182	$3,138	$1,470	$787
61–68 years	1889–96	38–45	8,280	5,391	3,497	1,800	770
53–60 years	1897–1904	30–37	7,720	5,264	3,502	2,165	1,157
45–52 years	1905–12	22–29	7,226	4,907	3,380	2,364	1,441
41–44 years	1913–16	18–21	6,204	4,441	3,211	2,256	1,491
37–40 years	1917–20	14–17	5,336	3,953	2,977	2,173	1,463
33–36 years	1921–24	10–13	4,259	3,334	2,569	1,958	1,358
31–32 years	1925–26	8–9	3,496	2,840	2,294	1,817	1,276
29–30 years	1927–28	6–7	3,004	2,467	2,023	1,568	1,061
28 years	1929	5	2,567	2,162	1,858	1,431	998
27 years	1930	4	2,318	1,987	1,666	1,256	865
26 years	1931	3	2,100	1,816	1,441	1,067	631
25 years	1932	2	1,952	1,581	1,275	945	495
24 years	1933	1	1,801	1,454	1,139	813	333
23 years [1]	1934	0	1,310	927	598	299	120

[1] Averages for annual income in the year of graduation are probably seriously in error because they are a combination of careful reports in which earnings are given in the 6 remaining months of the year following graduation, and reports of annual rates. The reader is advised generally to disregard these figures, and to study for this graduating class monthly rates of engineering income.

progressively slower up to the respective maxima of the five income groups or levels. The age spans of these phases differed with the income level. Thus, for the middle and two lower levels of income in 1929, the maximum yearly increase of $450 was reached at the age of 25. On the other hand, the initial periods of rapid rise for the upper

25- and 10-percent levels were not reached until the ages of 27 and 34 respectively. The subsequent periods of increase for the upper 10 percent embraced the age spans of 34 to 44, and 44 to 60, whereas those for the next highest income level extended from 27 to 38, and 38 to 60 years of age. The three remaining income levels increased at practically the same rate between 25 and 34 years. But while the age span for the third phase of increase was from 34 to 52 for the middle level, it extended only from 34 to 44 in the case of the two lower levels of income.

There was also an increased spread of earnings with advancing age. Even in the early ages there was a fairly considerable range. Thus, in 1929, among those who graduated in 1927, or 1928, the lowest quarter earned less than $1,822, whereas the earnings of the highest quarter were about one-third higher than this amount, or $2,497 per annum. It is also true that the highest 10 percent of these ages earned at least twice as much as the lowest 10 percent. But among engineers who were about 52 in 1929, the highest-paid quarter earned at least twice as much as the lowest-paid quarter, and the highest 10 percent earned more than four times as much as the lowest 10 percent. Similar relationships existed in 1932 and 1934, although the range of increases was due in large part to the influence of unemployment on the earnings in the lower levels of income.

The spread in earnings was accentuated beyond the age of 38. At that point, the income curve of the upper 10 percent diverged upward and continued thus to the age of 60. On the other hand, the remaining curves ran consistently parallel up to their respective maxima. For example, at the ages of 25, 44, 52, and 60 the incomes of the upper 25 percent differed from the median by 19, 41, 45, and 51 percent, while the order of differences for the lower 25 percent was 13, 26, 29, and 32 percent. By contrast, the corresponding incomes of the upper 10 percent at these ages were greater than the median by 45, 116, 138, and 157 percent. Clearly, beyond the age of 44, the earned annual incomes reported in 1929 by the upper 10 percent of all engineers differed very greatly from those in the other income levels, and this advantage in earning capacity was maintained in 1932 and 1934 also.

The earnings of engineers in the lower income brackets ceased to increase at a relatively early age. It is only approximately correct to assume that ability and income are in direct proportion. By and large, however, it is perhaps safe to assume that the engineers at any age in the lowest 10-percent income group are less able than the average at that age; and that the highest 10 percent are substantially more able than the average. The Bureau's data reveal that the maximum earnings of the lowest 10 and 25 percent were reached in 1929

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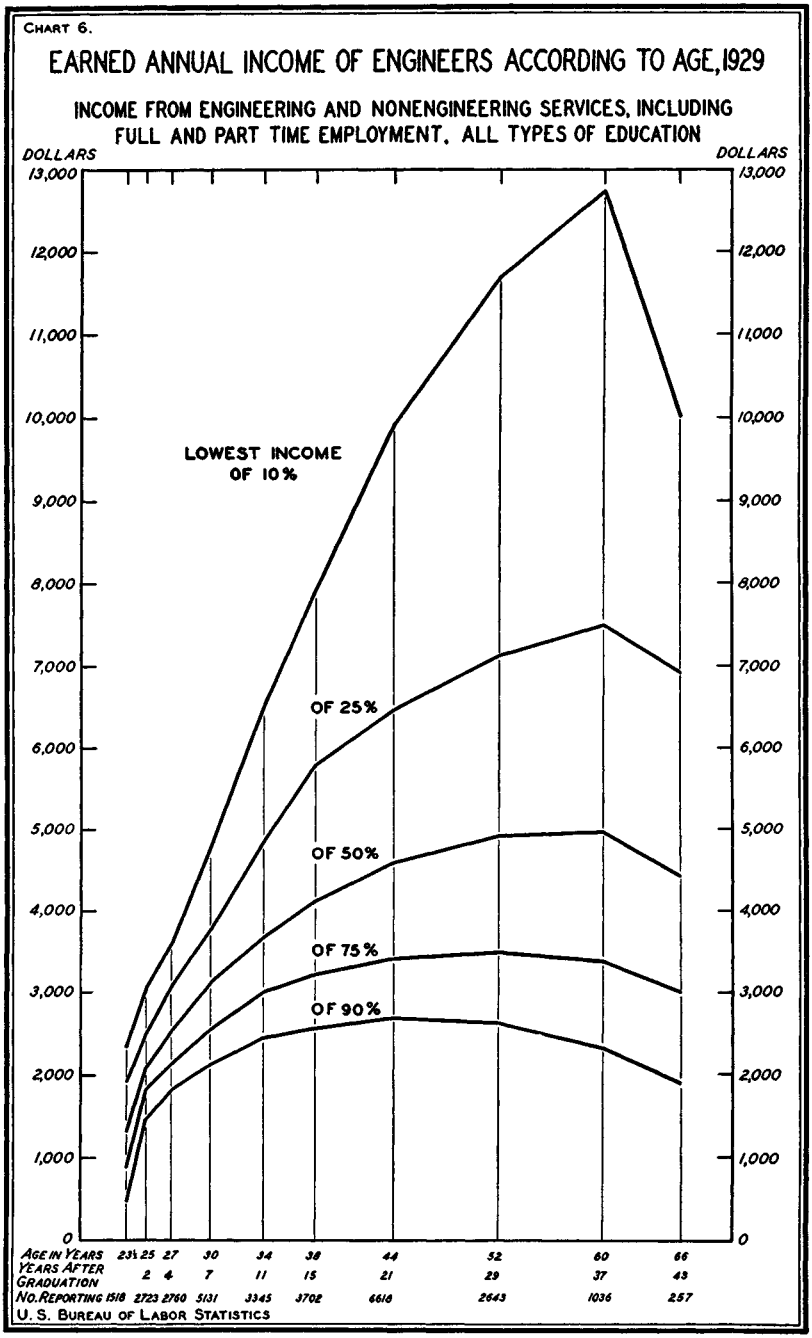
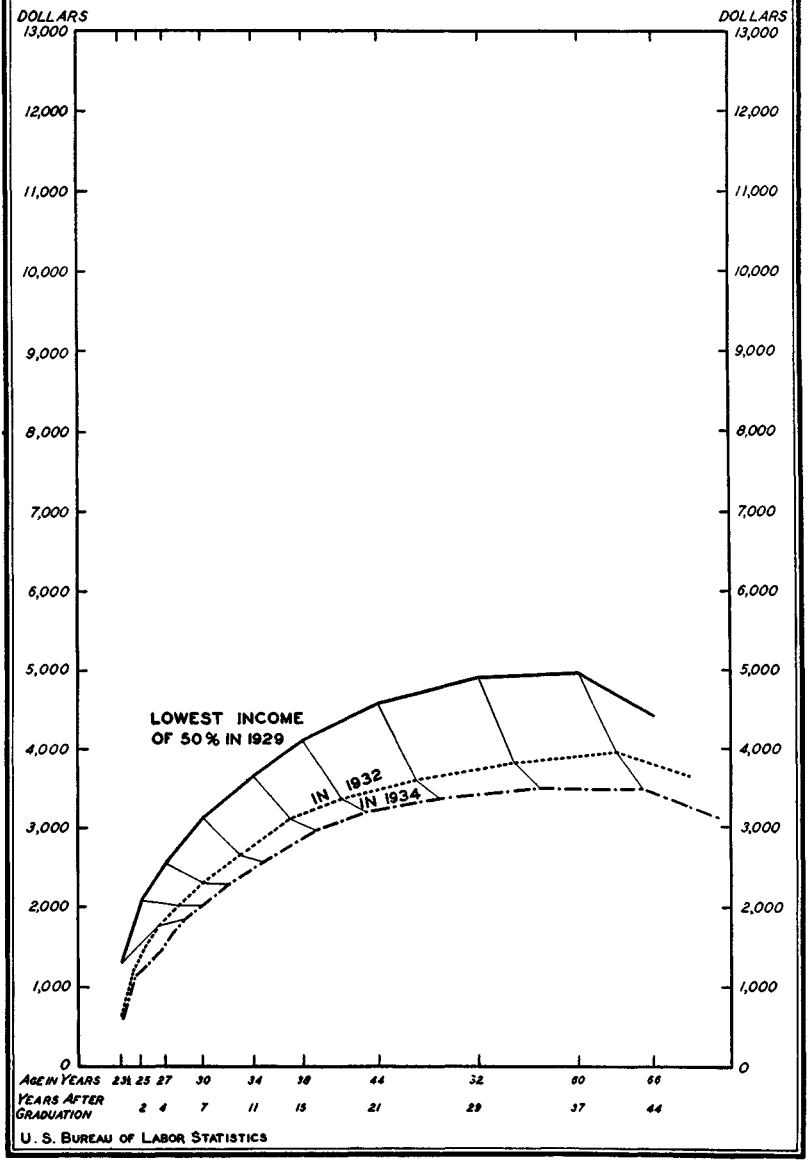


CHART 7.

MEDIANS OF EARNED ANNUAL INCOME ACCORDING TO AGE 1929, 1932 AND 1934

INCOME FROM ENGINEERING AND NONENGINEERING SERVICES INCLUDING FULL AND PART TIME EMPLOYMENT, ALL TYPES OF EDUCATION



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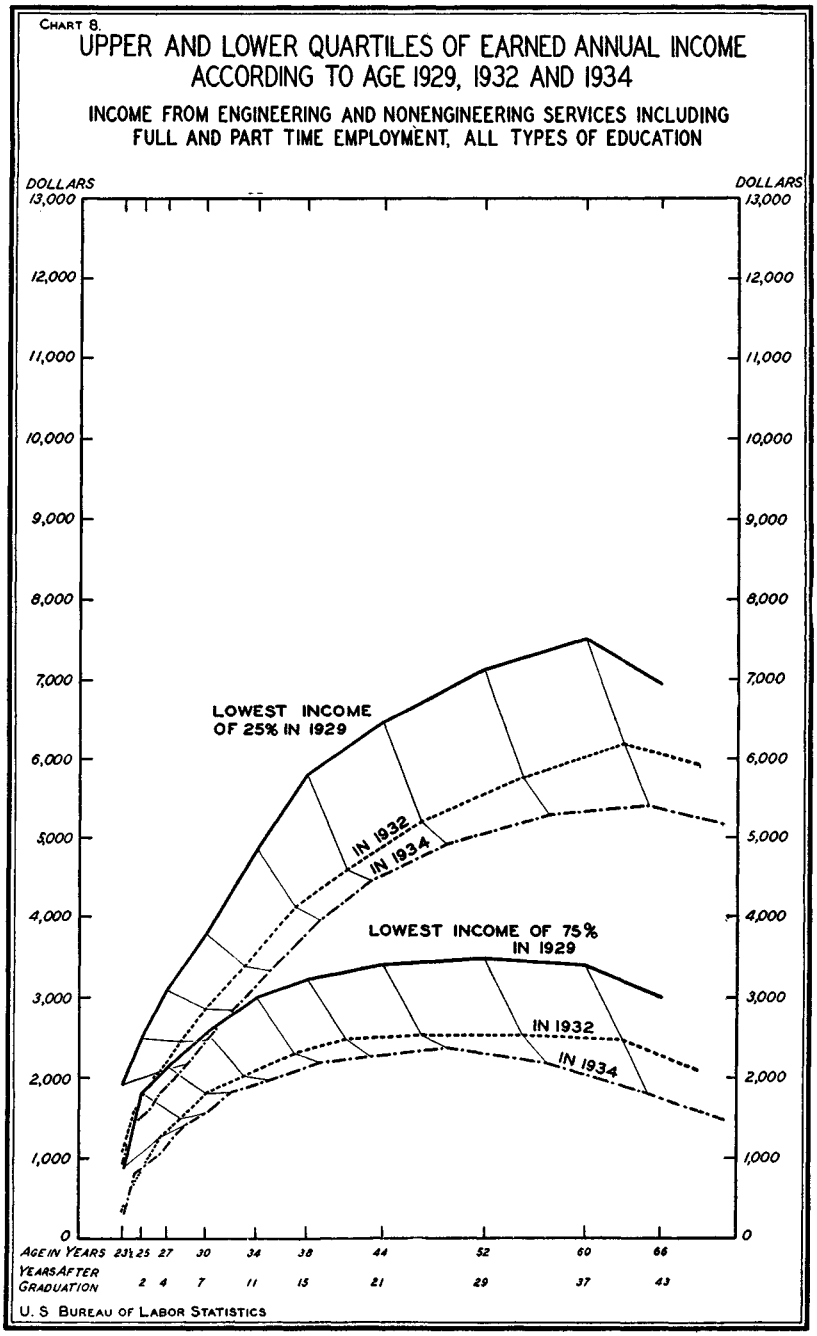
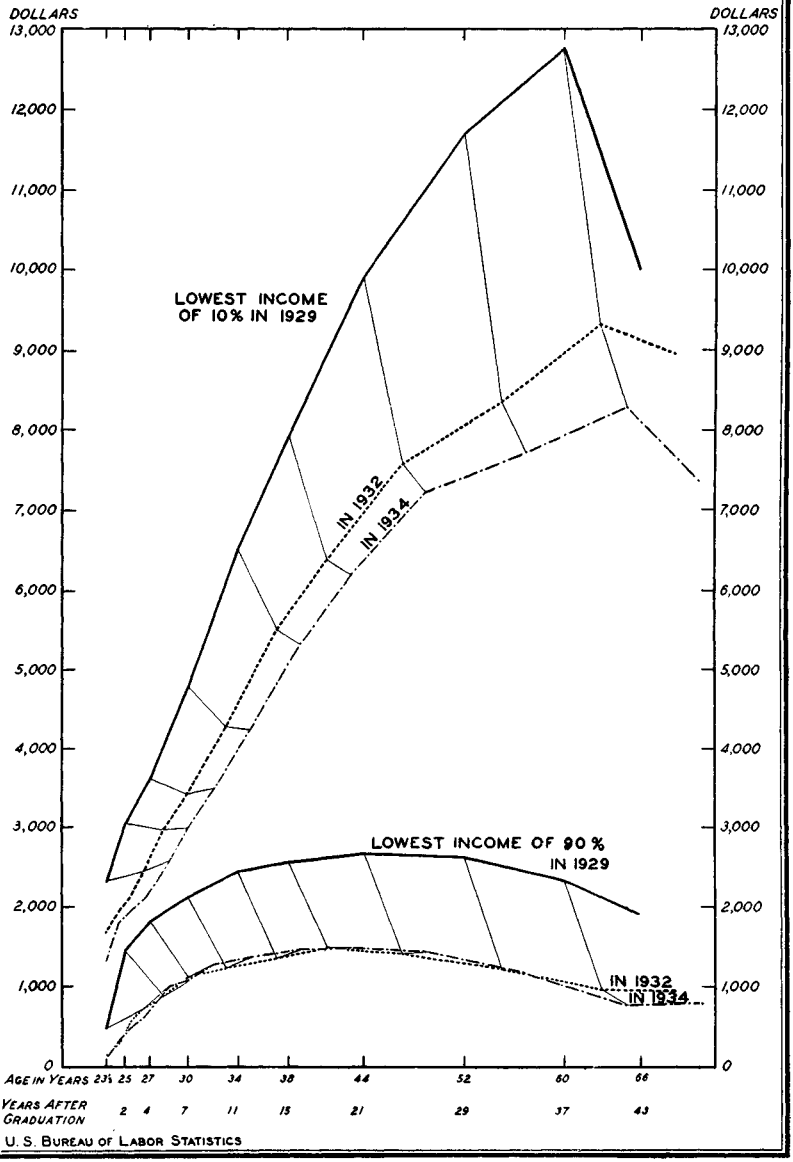


CHART 9.

UPPER AND LOWER DECILES OF EARNED ANNUAL INCOME ACCORDING TO AGE 1929, 1932 AND 1934

INCOME FROM ENGINEERING AND NONENGINEERING SERVICES INCLUDING FULL AND PART TIME EMPLOYMENT, ALL TYPES OF EDUCATION



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at about 44 years of age, and the average engineer reached his maximum earnings at about 52. The same relationship held in 1932 and 1934.

In the two later years the maximum for the average engineer occurred at about 60, but it is evident that earning power for engineers above the average continued to rise beyond this age. Thus, the average earnings of engineers 53 to 60 years of age in 1934 exceeded $3,502, whereas the average earnings of those 61 to 68 years were more than $3,497. But the highest 10 percent of the first group earned over $7,720, whereas the same class of the second group earned more than $8,280.

Table 50 discloses differences in the age-income cycles beyond the points of maximum earnings, that is, at the end of the third phases of increase. In the case of the two higher income levels, the fourth and last phase in 1929 was one of decrease. This was not so for the three lower income levels. For them, there was a fourth phase of no change in income which covered a span of approximately 8 years: 52 to 60 for the middle group, and from 44 to 52 in the case of the two lower levels. The fifth phases were ones of decrease. Relatively, however, the steepest declines occurred in the two higher income levels.

Incomes in Relation to Advancing Age and Experience

Changes in income brought about by the depression in various years may be considered from the point of view of particular individuals whose age and experience was increasing, or from the point of view of the expectations of men with comparable periods of experience. For example, the average earnings of engineers who graduated in 1927–28 declined only from $2,098 in 1929 to $2,020 in 1932, and increased slightly to $2,023 in 1934. On the other hand, those who graduated in 1897–1904 averaged $4,918 in 1929, $3,832 in 1932, and $3,502 in 1934. Such comparisons for each group of engineers over the period 1929–34 may be made from table 50. They are, however, more conveniently arranged for direct comparison in table 51.

This table shows a rise in earnings for the youngest engineers in the profession in 1929, who were near to 30 years of age in 1934. The advance in earning capacity in the first 5 years of engineering experience was so great that it offset the influence of the depression in the case of the youngest engineers. At higher ages, when an added year's experience influenced income less, the incomes of particular engineers declined by as much as 30 percent for the average graduate of the classes of 1889–96. In general, the older the group the greater was the decline in the average income of the group.

TABLE 51.—*Comparison of 5 levels of annual earnings in 1929, 1932, and 1934 of 5 age groups of older [1] engineers reporting*

[Without regard to employment status reported or type of education]

Percentage at specified income level	Annual earnings of more than specified amount of engineers whose ages were—														
	60 in 1929	63 in 1932	65 in 1934	38 in 1929	41 in 1932	43 in 1934	30 in 1929	33 in 1932	35 in 1934	25 in 1929	28 in 1932	30 in 1934	23½ in 1929	26½ in 1932	28½ in 1934
	Dol.	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
10 percent	12,749	9,318	8,280	7,936	6,395	6,204	4,797	4,287	4,259	3,049	2,970	3,004	2,330	2,451	2,567
25 percent	7,493	6,167	5,391	5,802	4,592	4,441	3,786	3,386	3,334	2,497	2,452	2,467	1,922	2,075	2,162
50 percent	4,968	3,959	3,497	4,121	3,385	3,211	3,145	2,677	2,569	2,098	2,020	2,023	1,313	1,772	1,858
75 percent	3,378	2,462	1,800	3,210	2,475	2,256	2,567	2,025	1,958	1,822	1,504	1,568	882	1,271	1,431
90 percent	2,328	964	770	2,563	1,478	1,491	2,130	1,229	1,358	1,462	876	1,061	478	735	998
	Percentage increase or decrease														
	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34
10 percent	−35	−27	−11	−22	−19	−3	−11	−11	−1	−1	−3	+1	+10	+5	+5
25 percent	−28	−18	−13	−23	−21	−3	−12	−11	−2	−1	−2	+1	+12	+8	+4
50 percent	−30	−20	−12	−22	−18	−5	−18	−15	−4	−4	−4	0	+42	+35	+5
75 percent	−47	−27	−27	−30	−23	−9	−24	−21	−3	−14	−17	+4	+62	+44	+13
90 percent	−67	−59	−20	−42	−42	+1	−36	−42	+10	−27	−40	+21	+109	+54	+36

[1] Includes graduate and "other" engineers who reported they were professionally active prior to 1930.

Incomes of Engineers of Identical Ages

In order to trace the influence of the depression on professional opportunity and on the normal expectations of members of the profession, table 52 compares the earnings for identical ages in each of the 3 years.[6]

For each level of experience, incomes declined from 1929 to 1934, and two-thirds to three-quarters of this decline occurred from 1929 to 1932. Over the entire period the average income of those who had been out of college for 2 years declined 43 percent. Those who had been out 5 years had, on the average, 35 percent less income in 1934 than the corresponding group in 1929. For older engineers, the decline approximated 30 percent, being slightly more than this for those with 10 years' experience, and slightly less for those with 20 years' experience.

The most significant differences brought about by the depression were in the spread of incomes at various ages. In all cases, primarily because of the influence of unemployment, annual income for the lowest 25 percent and the lowest 10 percent declined more than the average income at a given age. Thus, 2 years after graduation, 10 percent of the engineers earned less than $1,462 in 1929 as compared with a corresponding group earning less than $410 in 1934. This was a decline of 72 percent as compared with a 43 percent decline for the average at this age. Similarly, the average for engineers 30 years

[6] The figures are not derived from direct tabulations which were made on the basis of the same combinations of years of birth or graduation in each of the 3 years, but the movements of earnings proved to be sufficiently regular to justify reading the values for particular ages from the chart.

after graduation declined 30 percent from 1929 to 1934, while the level below which the earnings of 10 percent of such engineers were found fell by 50 percent.

TABLE 52.—*Comparison of 5 levels of annual earnings in 1929, 1932, and 1934 for corresponding years after graduation*

[Without regard to employment status reported or type of education]

Age of engineers	Years after graduation	Proportion with annual earnings of more than specified amount														
		10 percent'			25 percent			50 percent			75 percent			90 percent		
		1929	1932	1934	1929	1932	1934	1929	1932	1934	1929	1932	1934	1929	1932	1934
		Dol.	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
23½ years	½	2,330	1,673	1,310	1,922	1,097	927	1,313	645	598	882	322	299	478	129	120
25 years	2	3,049	2,150	1,880	2,497	1,750	1,500	2,098	1,399	1,190	1,822	840	860	1,462	420	410
28 years	5	3,980	2,970	2,410	3,300	2,452	2,080	2,710	2,020	1,750	2,275	1,504	1,340	1,925	876	940
33 years	10	6,000	4,287	3,700	4,560	3,386	2,990	3,500	2,677	2,380	2,890	2,025	1,850	2,375	1,229	1,299
43 years	20	9,450	6,680	6,204	6,350	4,750	4,441	4,450	3,420	3,211	3,380	2,490	2,256	2,650	1,460	1,491
53 years	30	11,700	8,000	7,450	7,190	5,580	5,050	4,900	3,780	3,420	3,430	2,520	2,240	2,590	1,285	1,286
60 years	37	12,749	8,900	7,900	7,493	5,960	5,250	4,968	3,900	3,500	3,378	2,490	2,010	2,328	1,050	980
		Percentage increase or decrease														
		1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34
23½ years	½	−44	−28	−22	−52	−43	−15	−54	−51	−7	−66	−63	−1	−75	−73	−1
25 years	2	−38	−29	−13	−40	−30	−14	−43	−33	−13	−53	−54	+2	−72	−71	−2
28 years	5	−39	−25	−19	−37	−26	−15	−35	−25	−13	−41	−34	−11	−51	−54	+7
33 years	10	−38	−29	−14	−34	−26	−12	−32	−24	−11	−36	−30	−9	−45	−48	+6
43 years	20	−34	−29	−7	−30	−25	−7	−28	−23	−6	−33	−26	−9	−44	−45	+2
53 years	30	−36	−32	−7	−30	−22	−9	−30	−23	−10	−35	−27	−11	−50	−50	0
60 years	37	−38	−30	−11	−30	−20	−12	−30	−21	−10	−40	−26	−19	−58	−55	−7

There was comparatively little difference for the various ages in the decline of the median income or in the decline of the level of income above which only 25 percent of the engineers of corresponding ages were found. The highest level of income (that achieved by only 10 percent at each age) declined more than the average in the case of all groups of engineers with 5 years' or more experience. Thus this select group among engineers 60 years of age lost 38 percent from 1929 to 1934, whereas the average decline at that age was 30 percent.

Annual Income and Education, Without Regard to Age

The foregoing analysis of annual incomes reported by professional engineers for 1929, 1932, and 1934 took no account of differences in educational background. In 1929, some 22,386, or 86 percent, of the 24,826 older graduates in engineering courses in the sample reported income and 7,646, or 90 percent, of the 8,440 older "other" engineers who were in the profession in 1929 reported. The five income levels for these two groups are shown in table 53.

TABLE 53.—*Comparison of 5 levels of annual earnings in 1929, 1932, and 1934 of older [1] graduate [2] and "other" [3] engineers reporting, by professional class*

[Without regard to employment status reported]

Percentage of professional class [4] at specified income level	Annual earnings of more than specified amount						Percentage income of "other" engineers formed of that of graduate engineers—		
	Graduate engineers [2]			"Other" engineers [3]					
	1929	1932	1934	1929	1932	1934	1929	1932	1934
10 percent:									
Mining and metallurgical	$10,015	$7,413	$7,530	$8,940	$6,370	$6,263	89	86	83
Chemical and ceramic	9,173	7,432	7,414	8,100	6,435	6,795	88	87	92
Mechanical and industrial	8,715	6,481	6,269	8,161	6,273	5,997	94	97	96
Electrical	7,301	6,263	6,084	6,654	5,943	5,670	91	95	93
Civil, agricultural, and architectural	6,853	5,478	5,133	5,745	4,470	4,222	84	82	82
25 percent:									
Mining and metallurgical	6,349	4,973	4,833	6,025	4,640	4,587	95	93	95
Chemical and ceramic	6,111	5,116	4,976	5,210	4,540	4,335	85	89	87
Mechanical and industrial	5,603	4,414	4,262	5,536	4,269	3,972	99	97	93
Electrical	4,886	4,175	4,062	4,497	3,762	3,654	92	90	90
Civil, agricultural, and architectural	4,732	3,923	3,671	4,036	3,349	3,163	85	85	86
50 percent:									
Mining and metallurgical	4,053	3,299	3,227	3,762	3,082	3,072	93	93	95
Chemical and ceramic	3,839	3,368	3,308	3,525	3,050	2,857	92	91	86
Mechanical and industrial	3,663	3,025	2,848	3,777	2,929	2,645	103	97	93
Civil, agricultural, and architectural	3,375	2,834	2,636	3,099	2,530	2,362	92	89	90
Electrical	3,296	2,863	2,821	3,213	2,627	2,517	97	92	89
75 percent:									
Mining and metallurgical	2,841	2,013	2,029	2,829	2,013	1,947	99	100	96
Mechanical and industrial	2,556	1,981	1,952	2,902	1,930	1,837	114	97	94
Civil, agricultural, and architectural	2,541	2,009	1,956	2,429	1,860	1,747	96	93	89
Chemical and ceramic	2,538	2,178	2,195	2,540	1,885	1,834	100	87	84
Electrical	2,317	1,997	2,003	2,400	1,883	1,792	104	94	89
90 percent:									
Mining and metallurgical	1,977	1,052	1,279	2,030	1,210	1,283	103	115	100
Civil, agricultural, and architectural	1,935	1,136	1,361	1,910	1,028	1,152	99	90	85
Mechanical and industrial	1,888	1,212	1,245	2,170	1,040	1,169	115	86	94
Chemical and ceramic	1,657	1,443	1,458	1,820	699	783	110	48	54
Electrical	1,609	1,311	1,308	1,860	1,185	1,088	116	90	83

[1] Includes those engineers who reported they were professionally active prior to 1930.
[2] Graduate engineers include all postgraduates, nonengineering graduates, and first-degree engineering graduates.
[3] "Other" engineers include all engineers with college course incomplete, noncollegiate technical school course, and secondary school education.
[4] Arrange in ascending order of graduates' annual earnings for 1929.

Consideration of the ratios derived from the 1929 earnings reported by the "other" and graduate engineers clearly indicates that those with a formal engineering education had higher incomes. Thus, in the highest 10- and 25-percent income groups, the earnings of the graduates in each professional class exceeded those of the "other" engineers. It will, however, be noted that there were wide variations in the ratios in the earnings of the two groups, indicating that the differentials in earnings do not accrue in equal measure for all five professional classes. In the upper 25-percent level, the order of yearly differences in favor of the graduates was $901, $696, $389, $324, and $67, the three smallest of these being in the electrical, mining and metallurgical, and mechanical and industrial classes. In the highest income level, differences of $647 and $554 per year were reported by the graduate electrical and mechanical and industrial engineers; in the three remaining professional classes none of the graduate groups reported

differentials of less than $1,000 per year. In general, from 1929 to 1934, the earnings of the upper 25 percent of the older graduates and of the "other" engineers declined by similar amounts.

The advantage enjoyed by engineers with college degrees is less marked at the lower levels. The average income of mechanical engineers in the profession in 1929 reporting income for 1929 was actually higher for noncollege graduates than for graduates. This was the only professional class of which this was true for the average, but, in general, the lowest 25 percent and the lowest 10 percent among the "other" engineers had higher incomes than among the graduates. But even at these levels, it will be seen that an advantage accrued over the period 1929 to 1934 to the college graduates. The income of the lowest 25 percent of those graduating prior to 1929 declined less than the income of the lowest 25 percent of the corresponding group of "other" engineers, and by 1934 college graduates had the higher incomes even at this level.

Annual Income Related to Age and Type of Education

The apparent advantage enjoyed in 1929 by the "other" engineers at the lower levels of income may best be explained in conjunction with the data in tables 54 and 55. The data for the median values[7] only of earned annual income of all engineers classified by age in the three years, 1929, 1932, and 1934 are presented in table 54.[8]

The first observation to be made has regard to the fact that the "other" engineers, at a very early age, lose the advantage in earning capacity arising from practical experience gained while the college graduate is in school. This loss of advantage is best exemplified by considering the ranking order of the 12 groups of engineers at corresponding years after graduation (table 55).

[7] The middle value of earned annual income—50 percent earning more and 50 percent earning less than the figure shown.

[8] Insufficient data were furnished for the two lower and higher income levels to enable a complete comparison for all age groups and all types of education.

TABLE 54.—*Median annual earnings in 1929, 1932, and 1934 of all engineers reporting, by age and type of education*

[Without regard to employment status reported]

Age	Year of graduation	Years after graduation	Postgraduates	Nonengineering graduates	First-degree engineering graduates					Others with—				Secondary-school education
					Chemical and ceramic	Civil, agricultural, and architectural	Electrical	Mechanical and industrial	Mining and metallurgical	College course incomplete		Noncollegiate technical course		
										Civil, agricultural, and architectural	Mechanical and all others [3]	Civil, agricultural, and architectural	Mechanical and all others [3]	
			1929 income (in dollars)											
64 and over	(1)	41+	(2)	6,000	(2)	4,460	(2)	5,100	4,800	3,400	5,700	(2)	(2)	3,800
56–63	1889–96	33–40	6,030	5,500	6,450	4,981	5,580	6,255	6,180	3,733	4,933	3,657	4,440	4,120
48–55	1897–04	25–32	5,320	5,663	6,600	4,804	5,460	5,793	5,200	3,774	5,179	3,514	4,714	4,333
40–47	1905–12	17–24	5,000	5,000	6,429	4,411	5,239	5,434	5,400	3,565	4,579	3,500	4,246	3,708
36–39	1913–16	13–16	4,286	4,933	6,021	3,964	4,480	4,878	4,825	3,328	4,031	3,168	3,889	3,625
32–35	1917–20	9–12	3,608	4,086	4,523	3,616	4,048	4,057	4,600	3,036	3,793	3,121	3,448	3,267
28–31	1921–24	5–8	3,164	3,072	3,544	3,122	3,190	3,354	3,306	2,614	3,200	2,574	2,925	2,814
26–27	1925–26	3–4	2,565	2,675	2,729	2,579	2,505	2,616	2,840	2,410	2,468	2,400	2,482	2,250
24–25	1927–28	1–2	2,008	1,978	2,007	2,150	1,977	2,099	2,086	2,127	2,232	2,200	2,144	2,100
23	1929	0	1,040	1,500	1,200	1,256	996	1,146	1,175	2,062	2,129	1,780	1,950	1,900
			1932 income (in dollars)											
67 and over	(1)	44+	(2)	3,000	(2)	3,600	(2)	5,200	1,100	2,600	4,600	(2)	(2)	3,467
59–66	1889–96	36–43	5,160	4,600	(2)	4,090	4,733	4,700	5,000	2,950	3,600	2,933	3,400	3,433
51–58	1897–04	28–35	4,757	5,000	5,200	3,761	4,677	4,189	3,940	2,969	3,688	2,846	3,550	3,650
43–50	1905–12	20–27	4,155	4,475	5,320	3,533	4,214	4,070	4,222	3,038	3,631	2,777	3,241	3,178
39–42	1913–16	16–19	3,745	4,222	4,657	3,318	3,877	3,800	3,700	2,702	3,162	2,709	2,968	3,173
35–38	1917–20	12–15	3,377	3,600	3,773	3,048	3,509	3,470	3,444	2,518	3,029	2,475	2,682	2,720
31–34	1921–24	8–11	2,882	2,945	3,167	2,628	2,807	2,861	2,744	2,406	2,563	2,173	2,310	2,488
29–30	1925–26	6–7	2,472	2,655	2,580	2,343	2,309	2,403	2,200	2,090	2,105	1,971	2,000	2,057
27–28	1927–28	4–5	2,029	2,167	2,064	2,124	1,992	1,985	1,940	1,932	1,906	1,836	1,686	1,840
26	1929	3	1,794	1,800	1,773	1,896	1,660	1,716	1,560	1,657	1,638	1,900	1,600	1,350
25	1930	2	1,378	1,575	1,628	1,709	1,451	1,495	1,492	1,709	1,373	1,700	1,450	1,633
24	1931	1	948	1,367	1,208	1,349	1,032	1,247	1,147	1,620	1,390	(2)	1,600	1,700
23	1932	0	687	1,800	606	629	586	645	480	1,433	1,183	(2)	1,400	(2)
			1934 income (in dollars)											
69 and over	(1)	46+	(2)	3,100	(2)	3,200	(2)	3,933	1,200	2,000	3,400	(2)	2,000	3,100
61–68	1889–96	38–45	4,333	4,400	(2)	3,567	4,143	4,100	4,333	2,800	2,900	2,600	2,460	3,133
53–60	1897–04	30–37	4,488	4,400	5,100	3,337	4,400	3,731	3,900	2,787	3,493	2,429	3,364	3,508
45–52	1905–12	22–29	3,923	4,088	5,000	3,311	4,089	3,875	4,086	2,780	3,497	2,533	2,974	2,940
41–44	1913–16	18–21	3,517	4,467	4,111	3,129	3,917	3,538	3,588	2,496	2,990	2,420	2,713	3,031
37–40	1917–20	14–19	3,250	3,575	3,850	2,826	3,393	3,278	3,567	2,354	2,890	2,286	2,543	2,711
33–36	1921–24	10–13	2,864	2,857	3,244	2,516	2,801	2,704	2,811	2,147	2,432	2,036	2,161	2,356
31–32	1925–26	8–9	2,513	2,475	2,586	2,263	2,364	2,378	2,463	1,974	2,093	1,863	1,957	1,900
29–30	1927–28	6–7	2,072	2,200	2,225	2,069	2,021	2,058	2,100	1,875	1,911	1,567	1,738	1,860
28	1929	5	1,888	1,871	1,982	1,892	1,759	1,908	1,809	1,678	1,808	1,867	1,525	1,575
27	1930	4	1,563	1,800	1,795	1,762	1,527	1,719	1,542	1,518	1,500	1,800	1,433	1,660
26	1931	3	1,437	1,457	1,426	1,545	1,263	1,433	1,479	1,567	1,633	1,400	1,467	1,800
25	1932	2	1,255	1,233	1,286	1,384	1,138	1,261	1,241	1,388	1,400	(2)	1,367	(2)
24	1933	1	840	1,314	1,162	1,249	1,047	1,126	1,159	1,283	1,267	(2)	1,600	(2)
23	1934	0	612	1,000	567	638	540	560	564	1,200	1,089	(2)	1,263	1,325

[1] Prior to 1889.
[2] Fewer than 10 persons reported.
[3] Includes chemical and ceramic, electrical, industrial, and mining and metallurgical engineers.

CHART 10.

COMPARISON OF MEDIANS OF EARNED ANNUAL INCOME ACCORDING TO AGE, 1929

INCOME FROM ENGINEERING AND NONENGINEERING SERVICES, INCLUDING FULL AND PART TIME EMPLOYMENT FOR SPECIFIC TYPES OF EDUCATION

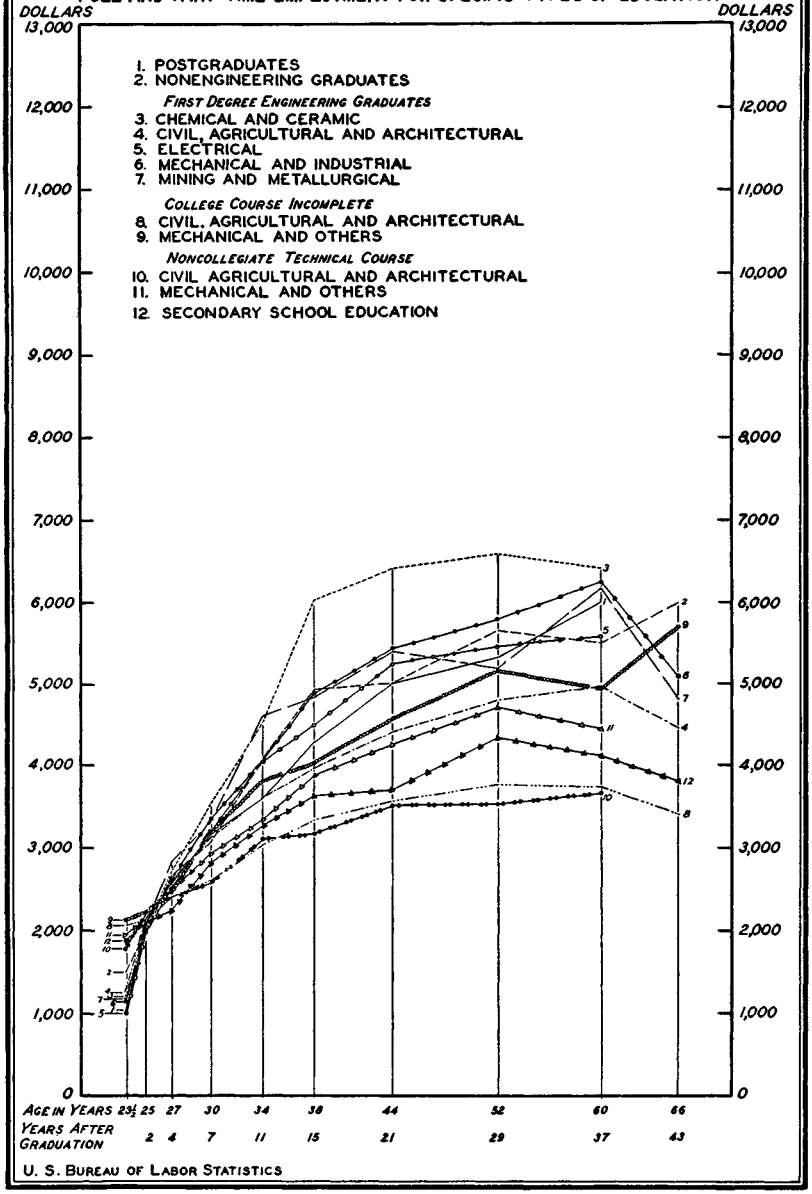

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TABLE 55.—*Rank of engineers of specified education according to median annual earnings in 1929 and 1934, for corresponding years after graduation*

[Without regard to employment status reported]

Type of education	Years after graduation											
	2	5	10	20	30	37	2	5	10	20	30	37
	Rank in 1929						Annual earnings in 1929					
College course incomplete: Mechanical and others[1]	1	8	6	7	7	8	$2,232	$2,650	$3,580	$4,425	$5,100	$4,933
Noncollegiate technical course: Civil, agricultural, and architectural	2	11	11	12	12	12	2,200	2,450	2,950	3,425	3,550	3,657
First-degree engineering graduates: Civil, agricultural, and architectural	3	5	7	8	8	7	2,150	2,750	3,490	4,300	4,800	4,981
Noncollegiate technical course: Mechanical and others[1]	4	9	9	9	9	9	2,144	2,600	3,300	4,190	4,650	4,440
College course incomplete: Civil, agricultural, and architectural	5	10	12	11	11	11	2,127	2,475	2,900	3,500	3,750	3,733
Secondary-school education	6	12	10	10	10	10	2,100	2,430	3,150	3,700	4,275	4,120
First-degree engineering graduates:												
Mechanical and industrial	7	3	3	2	2	2	2,099	2,825	3,875	5,350	5,800	6,255
Mining and metallurgical	8	2	2	3	6	3	2,086	2,975	4,200	5,300	5,350	6,180
Postgraduates	9	6	8	6	5	4	2,008	2,750	3,475	4,850	5,375	6,030
First-degree engineering graduates: Chemical and ceramic	10	1	1	1	1	1	2,007	3,000	4,250	6,350	6,600	6,450
Nonengineering graduates	11	4	5	5	3	6	1,978	2,800	3,800	4,990	5,600	5,500
First-degree engineering graduates: Electrical	12	7	4	4	4	5	1,977	2,725	3,800	5,075	5,450	5,580
	Rank in 1934						Annual earnings in 1934					
Secondary-school education	1	9	9	8	9	8	$1,550	$1,625	$2,025	$3,031	$3,200	$3,350
Noncollegiate technical course: Mechanical and others[1]	2	12	10	10	10	10	1,475	1,475	2,010	2,713	3,150	2,980
College course incomplete: Mechanical and others[1]	3	10	8	9	7	9	1,350	1,600	2,200	2,990	3,490	3,200
Noncollegiate technical course: Civil, agricultural, and architectural	4	2	12	12	12	12	(2)	1,830	1,900	2,420	2,490	2,490
First-degree engineering graduates: Civil, agricultural, and architectural	5	5	7	7	8	7	1,325	1,800	2,350	3,129	3,300	3,400
College course incomplete: Civil, agricultural, and architectural	6	11	11	11	11	11	1,300	1,600	2,000	2,496	2,780	2,790
Nonengineering graduates	7	3	3	1	2	3	1,275	1,825	2,600	4,467	4,250	4,400
First-degree engineering graduates:												
Chemical and ceramic	8	1	1	2	1	1	1,250	1,875	2,750	4,111	5,050	(2)
Mining and metallurgical	9	7	4	4	5	5	1,200	1,700	2,550	3,588	3,980	4,050
Mechanical and industrial	10	4	6	5	6	6	1,180	1,825	2,490	3,538	3,780	3,880
Electrical	11	8	5	3	3	4	1,080	1,650	2,500	3,917	4,250	4,325
Postgraduates	12	6	2	6	4	2	940	1,750	2,610	3,517	4,175	4,425

[1] Includes chemical and ceramic, electrical, industrial, and mining and metallurgical engineers.
[2] Fewer than 10 engineers reported.

At the end of 2 years after graduation [9] in 1929, the "other" engineers held ranks 1, 2, 4, 5, and 6, the first-degree civil graduates were third, and the remaining graduate groups occupied positions 7 to 12, inclusive. Five years after graduation, however, there was a complete reversal of this situation, which placed all graduates ahead of the "other" engineers.

Relatively, the greatest shifts in position occurred between the second and fifth years after graduation. Secondary-school engineers dropped from sixth to twelfth place. The noncollegiate civil engineers declined from second to eleventh place, while the civil engineers whose

[9] The incomes reported just after graduation are not compared. These are invalidated by the fact that, while the graduates could have reported incomes for 6 months only, it was possible for the "other" engineers to have reported an income for a full year or more.

college course was incomplete declined from fifth to tenth place. Positions 8 and 9, respectively, were occupied by the mechanical engineers whose college course was incomplete and by those who were graduates of noncollegiate technical schools; 2 years after graduation they had held first and fourth places. Among the engineering graduates, the greatest shift in position occurred among the first-degree chemical and ceramic engineers, who moved from tenth to first place at 5 years after graduation, and maintained that position throughout the 1929 age cycle. It will also be noted that the 1929 earnings reported by the first-degree civil engineers were greater at 5 years after graduation than those of both postgraduates and first-degree electrical engineers. On the other hand, the earnings of these three groups were less than those reported by first-degree mining and metallurgical, and mechanical and industrial engineers, and nonengineering graduates.

Thus, it follows that the greater decline from 1929 to 1934 in the incomes of the lower 10 and 25 percent of the "other" engineers reflects in part the greater advantage of 5 years' additional experience among the younger college graduates.

Between 5 and 10 years after graduation, there were but slight changes in relative position. At the latter period, however, all first-degree and nonengineering graduates were ahead of the postgraduate engineers. The secondary-school engineers reported earnings greater than either of the two groups of "other" civil engineers. The "other" mechanical engineers trained in noncollegiate technical schools followed ninth in order, after the postgraduates.

At 20 years after graduation, the first-degree civil engineers ranked below both the "other" mechanical engineers whose college course was incomplete and the postgraduate engineers; between 20 and 37 years after graduation, the relative standing of the several groups remained comparatively stable. It will also be noted that even in 1934 the order of the groups shows no marked departure from the situation which prevailed in 1929.

A further explanation may be given of the apparent advantage of "other" engineers in the lower income levels, as shown in table 53. There are too few cases to warrant showing text tables of income for the lowest 10 and 25 percent of the engineers classified simultaneously by professional classifications, age, and type of education. But such values have been computed for every such classification embracing more than 100 reports and the results may be summarized. In 1929, at every age, the lowest 10 percent of the civil engineers with incomplete college courses had lower incomes than the lowest 10 percent of those with completed college courses. This continued to be true in 1934 for engineers who graduated prior to 1928, the last year with an adequate number of reports to warrant this particular comparison.

For the five age groups from 28 to 47 for which comparisons can be made, the lowest 10 percent of civil engineers with noncollegiate technical school courses had lower incomes than those with incomplete college courses. These statements hold, not only for the lowest 10 percent of the civil engineers but also for the lowest 25 percent. There are not enough cases of engineers in the professional classes, other than civil engineers, to warrant a detailed analysis of nongraduates on an age basis for the separate classes. But the income of the lowest 10 and 25 percent of the nongraduates of the four classes combined is less than the corresponding level of income for graduates in any of the professional classes at almost all ages for which comparisons can be made. It seems highly probable, in the light of these facts, that part of the advantage shown by "other" engineers in table 53 is due to a higher age among the nongraduates in the groups compared.

Table 55 also shows that, although the earnings reported in 1929 by the "other" engineers at 2 years after graduation were higher than those of the graduates, the differentials were not great. For the former, the 1929 median earnings ranged from $2,100 in the case of secondary-school engineers to $2,232 for mechanical engineers who had not completed their college course, while the range for the latter was from $1,977 for electrical to $2,099 for mechanical and industrial engineers. At 5 years after graduation, when the positions were reversed, the differentials were still slight. The earnings of the graduates ranged from $2,725 to $3,000 per year and those of the "other" engineers from $2,430 to $2,650. With advancing age, however, the spreads in earnings in favor of the graduates became very marked. In the case of mechanical engineers, for instance, the differences in earnings between the first-degree engineers and those who did not complete their college course were $175, $295, $925, $700, and $1,322 per year, and between first-degree and noncollegiate mechanical engineers they were $225, $575, $1,160, $1,150, and $1,815 per annum. Similarly, for the civil engineers, the differences in earnings between those with first-degrees and those whose college course was incomplete were $275, $590, $800, $1,050, and $1,248 per year, while between first-degree civil and noncollegiate technical school engineers, the order was $300, $540, $875, $1,250, and $1,324 per annum.

Even among the graduate groups there was variation in earning capacity. Thus, while the earnings of first-degree civil engineers ranged from $2,750 to $4,800 per year between 5 and 30 years after graduation, the range for the first-degree chemical and ceramic engineers was from $3,000 to $6,600 per year. In other words, over a period of 25 years, the civil engineers' earnings increased by only $2,050, whereas those of engineers in the chemical and ceramic field increased by $3,600. The ranges in earnings of the remaining graduate

groups fell between those reported by the civil and the chemical and ceramic engineers.

Earnings of the "other" engineers ceased to increase several years before those of the graduates. Their earnings began to decline after 55 years of age in 1929, whereas the earnings of the graduates continued to increase even at 64 years of age and over (table 54).

When consideration is given to the changes in income status between 1929 and 1934 of selected age groups of engineers in each type of education, it appears, again, that the depression bore hardest upon the older engineers.

As indicated in table 56, over the period 1929–34 the decreases in earnings of engineers who were 60 years of age in 1929 and 65 in 1934 ranged from 20 to 45 percent. The smallest range, however, occurred among the graduate engineers. This is explained by the fact that for the "other" engineers, the earnings reported at the age of 60 in 1929 were those for the period of decline, since they were less than those reported for engineers who were 52 in 1929. When, however, comparison is made of the earnings for the 2 age groups of engineers who were 52 and 44, respectively, in 1929 and 5 years older in 1934, it will be noted that the decreases in their earnings over the period 1929–34 show little variation. The important thing to note is that the effect of the depression was approximately the same on both graduates and "other" engineers. On the other hand, for the 2 younger groups shown in table 56, the graduate engineers who were 25 in 1929, practically all showed increases in their earnings by 1934, whereas the "other" engineers showed further decreases. This situation was even more pronounced in favor of the graduate engineers who were 23½ years of age in 1929.

Throughout the whole of this analysis of differences in earnings by type of education, there have only been incidental references to the changes which occurred over the period 1929–34 and in the intervening periods, 1929–32 and 1932–34. It will be recalled, however, that the percentage decreases in the incomes for all engineers at corresponding years after graduation were practically the same. This was also the case for the 12 groups of engineers when segregated by type of education, as is evidenced by a consideration of the data shown in table 57.

At 5 years after graduation the range of decreases of earnings over the period 1929–34 was from 25 to 43 percent. At 10 years after graduation, the range was from 25 to 39 percent, while even at 30 years after graduation the percentage decreases ranged only from 22 to 35 percent. It will, however, be noted that the extremes of the ranges are the exception, indicating that regardless of types of education, the incomes of engineers of identical ages in 1929 and 1934 suffered about the same from the depression.

TABLE 56.—*Comparison of median annual earnings in 1929, 1932, and 1934 of selected age groups of engineers reporting, by type of education*

[Without regard to employment status reported]

Type of education	Engineers whose ages were—														
	60 in 1929	63 in 1932	65 in 1934	52 in 1929	55 in 1932	57 in 1934	44 in 1929	47 in 1932	49 in 1934	25 in 1929	28 in 1932	30 in 1934	23½ in 1929	26½ in 1932	28½ in 1934
	Median annual earnings														
Postgraduates	$6,030	$5,160	$4,333	$5,320	$4,757	$4,488	$5,000	$4,155	$3,923	$2,008	$2,029	$2,072	$1,040	$1,794	$1,888
Nonengineering graduates	5,500	4,600	4,400	5,663	5,000	4,400	5,000	4,475	4,088	1,978	2,167	2,200	1,500	1,800	1,871
First-degree engineering graduates:															
Chemical and ceramic	6,450	(2)	(2)	6,600	5,200	5,100	6,429	5,320	5,000	2,007	2,064	2,225	1,200	1,773	1,982
Civil, agricultural, and architectural	4,981	4,090	3,567	4,804	3,761	3,337	4,411	3,533	3,311	2,150	2,124	2,069	1,256	1,896	1,892
Electrical	5,580	4,733	4,143	5,460	4,677	4,400	5,239	4,214	4,089	1,977	1,992	2,021	996	1,660	1,759
Mechanical and industrial	6,255	4,700	4,100	5,793	4,189	3,731	5,434	4,070	3,875	2,099	1,985	2,058	1,146	1,716	1,908
Mining and metallurgical	6,180	5,000	4,333	5,200	3,940	3,900	5,400	4,222	4,086	2,086	1,940	2,100	1,175	1,560	1,809
College course incomplete:															
Civil, agricultural, and architectural	3,733	2,950	2,800	3,774	2,969	2,787	3,565	3,038	2,780	2,127	1,932	1,875	2,062	1,657	1,678
Mechanical and others [1]	4,933	3,600	2,900	5,179	3,688	3,493	4,579	3,631	3,497	2,232	1,906	1,911	2,129	1,638	1,808
Noncollegiate technical course:															
Civil, agricultural, and architectural	3,657	2,933	2,600	3,514	2,846	2,429	3,500	2,777	2,533	2,200	1,836	1,567	1,780	1,900	1,867
Mechanical and others [1]	4,440	3,400	2,460	4,714	3,550	3,364	4,246	3,241	2,974	2,144	1,686	1,738	1,950	1,600	1,525
Secondary-school education	4,120	3,433	3,133	4,333	3,650	3,508	3,708	3,178	2,940	2,100	1,840	1,860	1,900	1,350	1,575
	Percentage change														
	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34
Postgraduates	−28	−14	−16	−16	−11	−6	−22	−17	−6	+3	+1	+2	+82	+73	+5
Nonengineering graduates	−20	−16	−4	−22	−12	−12	−18	−11	−9	+11	+10	+2	+25	+20	+4
First-degree engineering graduates:															
Chemical and ceramic	(2)	(2)	(2)	−23	−21	−2	−22	−17	−6	+11	+3	+8	+65	+48	+12
Civil, agricultural, and architectural	−28	−18	−13	−31	−22	−11	−25	−20	−6	−4	−1	−3	+51	+51	0
Electrical	−26	−15	−12	−19	−14	−6	−22	−20	−3	+2	+1	+1	+77	+67	+6
Mechanical and industrial	−34	−25	−13	−36	−28	−11	−29	−25	−5	−2	−5	+4	+66	+50	+11
Mining and metallurgical	−30	−19	−13	−25	−24	−1	−24	−22	−3	+1	−7	+8	+54	+33	+16
College course incomplete:															
Civil, agricultural, and architectural	−25	−21	−5	−26	−21	−6	−22	−15	−8	−12	−9	−3	−19	−20	+1
Mechanical and others [1]	−41	−27	−19	−33	−29	−5	−24	−21	−4	−14	−15	0	−15	−23	+10
Noncollegiate technical course:															
Civil, agricultural, and architectural	−29	−20	−11	−31	−19	−15	−28	−21	−9	−29	−17	−15	+5	+7	−2
Mechanical and others [1]	−45	−23	−28	−29	−25	−5	−30	−24	−8	−19	−21	+3	−22	−18	−5
Secondary-school education	−24	−17	−9	−19	−16	−4	−21	−14	−7	−11	−12	+1	−17	−29	+17

[1] Includes chemical and ceramic, electrical, industrial and mining and metallurgical engineers.

[2] Fewer than 10 engineers reported.

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TABLE 57.—*Percentage decrease in median annual earnings, 1929 to 1934, for corresponding years after graduation, by type of education*

[Without regard to employment status reported]

Type of education	Percentage decrease in income, at end of specified period after graduation					
	2 years	5 years	10 years	20 years	30 years	37 years
Postgraduates	−53	−36	−25	−27	−22	−27
Nonengineering graduates	−36	−35	−32	−10	−24	−20
First-degree engineering graduates:						
Chemical and ceramic	−38	−38	−35	−35	−23	(2)
Civil, agricultural, and architectural	−38	−35	−33	−27	−31	−32
Electrical	−45	−39	−34	−23	−22	−22
Mechanical and industrial	−44	−35	−36	−34	−35	−38
Mining and metallurgical	−42	−43	−39	−32	−26	−34
College course incomplete:						
Civil, agricultural, and architectural	−39	−35	−31	−29	−26	−25
Mechanical and others [1]	−40	−40	−39	−32	−32	−35
Noncollegiate technical course:						
Civil, agricultural, and architectural	(2)	−25	−36	−29	−30	−32
Mechanical and others [1]	−31	−43	−39	−35	−32	−33
Secondary-school education	−26	−33	−36	−18	−25	−19

[1] Includes chemical and ceramic, electrical, industrial and mining, and metallurgical engineers.
[2] Fewer than 10 engineers reported in 1934.

Sources of Earned Annual Income, 1929 to 1934

Before presenting the annual incomes from all kinds of engineering work and nonengineering work attention is directed to the following:

It must be noted that the requirements of editing the questionnaires caused a relatively large proportion of the engineers engaged in nonengineering work in 1929 to be those who had college degrees in engineering. Thus, elsewhere it has been shown that the general movement from 1929 to 1934 was out of engineering work either into unemployment or into work not in the engineering field. Consequently a substantial number of those who were in pursuits other than engineering in 1929 would also have so reported in 1932 and 1934. Such returns from nonengineering graduates and "other" engineers were, in general, discarded. Therefore, the tabulations for nonengineering work in 1929 tend to be those of graduate engineers. On the other hand, a number of nongraduates who were practicing their profession in 1929 passed into nonengineering employment in 1932 and 1934. The schedules for such engineers were retained. Clearly the situation which prevailed in 1929 was less true in 1932 and 1934. Hence, it is as well to compare the earnings for nonengineering both with the earnings of graduates and with those of all persons reporting who were engaged in engineering. These data are presented in table 58.

TABLE 58.—*Comparison of 5 levels of annual earnings in 1929, 1932, and 1934 from nonengineering and engineering work, by age*

Age	Year of graduation	Years after graduation	Proportion with annual earnings of more than specified amount as derived from—													
			10 percent			25 percent			50 percent			75 percent			90 percent		
			Nonengineering work by all engineers [1]	Engineering work by—		Nonengineering work by all engineers [1]	Engineering work by—		Nonengineering work by all engineers [1]	Engineering work by—		Nonengineering work by all engineers [1]	Engineering work by—		Nonengineering work by all engineers [1]	Engineering work by—	
				All engineers [1]	All graduates		All engineers [1]	All graduates		All engineers [1]	All graduates		All engineers [1]	All graduates		All engineers [1]	All graduates
			1929 income (in dollars)														
64 years and over	Prior to 1889	41+	(2)	9,937	10,148	(2)	6,917	7,346	2,400	4,476	4,971	(2)	3,060	3,469	(2)	1,957	2,413
56–63 years	1889–96	33–40	(2)	12,625	13,516	7,155	7,500	7,955	4,400	4,979	5,590	2,893	3,422	3,760	(2)	2,420	2,624
48–55 years	1897–1904	25–32	12,495	11,709	12,478	7,867	7,108	7,610	5,057	4,912	5,232	3,494	3,481	3,777	2,280	2,661	3,020
40–47 years	1905–12	17–24	12,424	9,815	10,088	8,106	6,407	6,747	5,346	4,562	4,876	3,408	3,405	3,624	2,420	2,705	2,936
36–39 years	1913–16	13–16	10,140	7,751	8,294	6,620	5,680	6,099	4,347	4,102	4,353	3,013	3,210	3,354	1,998	2,582	2,756
32–35 years	1917–20	9–12	8,052	6,480	6,578	5,502	4,814	4,988	3,685	3,672	3,822	2,792	3,010	3,146	1,945	2,458	2,581
28–31 years	1921–24	5–8	5,460	4,753	4,842	4,099	3,776	3,847	3,042	3,145	3,207	2,349	2,577	2,664	1,642	2,150	2,258
26–27 years	1925–26	3–4	4,170	3,618	3,641	3,075	3,104	3,124	2,331	2,558	2,582	1,821	2,164	2,200	1,308	1,850	1,891
24–25 years	1927–28	1–2	2,910	3,043	2,992	2,344	2,501	2,477	1,786	2,105	2,095	1,407	1,834	1,831	889	1,476	1,493
23 years	1929	0	2,496	2,356	2,165	1,973	1,933	1,858	1,500	1,322	1,168	936	888	862	446	502	449
			1932 income (in dollars)														
67 years and over	Prior to 1889	44+	(2)	9,009	9,386	(2)	6,032	6,363	3,000	3,846	4,100	(2)	2,242	2,469	(2)	1,145	1,233
59–66 years	1889–96	36–43	(2)	9,020	9,643	5,000	6,252	6,589	2,550	4,126	4,689	1,200	2,640	3,143	(2)	1,300	1,571
51–58 years	1897–1904	28–35	9,146	8,405	9,008	5,069	5,892	6,163	3,011	4,046	4,411	1,395	2,823	3,119	525	1,807	1,989
43–50 years	1905–12	20–27	9,188	7,567	7,979	5,528	5,242	5,557	3,129	3,742	4,007	1,528	2,720	2,968	736	1,903	1,999
39–42 years	1913–16	16–19	7,450	6,387	6,700	4,980	4,643	4,990	2,800	3,490	3,711	1,602	2,604	2,854	809	1,926	2,090
35–38 years	1917–20	12–15	5,486	5,579	5,858	3,675	4,191	4,400	2,320	3,223	3,381	1,276	2,475	2,664	587	1,851	1,999
31–34 years	1921–24	8–11	4,290	4,332	4,415	3,007	3,457	3,546	1,963	2,790	2,885	1,123	2,195	2,299	490	1,619	1,728
29–30 years	1925–26	6–7	3,301	3,501	3,565	2,465	2,934	2,799	1,639	2,411	2,455	964	1,942	1,990	454	1,468	1,533
27–28 years	1927–28	4–5	2,463	3,005	3,021	1,908	2,504	2,521	1,319	2,103	2,128	765	1,702	1,751	306	1,257	1,310
26 years	1929	3	2,034	2,518	2,504	1,585	2,140	2,134	1,045	1,871	1,878	570	1,523	1,546	228	1,119	1,169
25 years	1930	2	1,930	2,167	2,155	1,465	1,946	1,941	1,069	1,662	1,658	585	1,325	1,324	234	937	927
24 years	1931	1	1,766	2,039	2,014	1,348	1,742	1,725	921	1,394	1,381	470	1,024	1,008	188	539	515
23 years	1932	0	1,689	1,910	1,826	1,240	1,335	1,243	814	766	716	406	383	358	163	153	143

See footnotes at end of table.

TABLE 58.—*Comparison of 5 levels of annual earnings in 1929, 1932, and 1934 from nonengineering and engineering work, by age*—Con.

Age	Year of graduation	Years after graduation	Proportion with annual earnings of more than specified amount as derived from—														
			10 percent			25 percent			50 percent			75 percent			90 percent		
			Non-engineering work by all engineers [1]	Engineering work by—		Non-engineering work by all engineers [1]	Engineering work by—		Non-engineering work by all engineers [1]	Engineering work by—		Non-engineering work by all engineers [1]	Engineering work by—		Non-engineering work by all engineers [1]	Engineering work by—	
				All engineers [1]	All graduates		All engineers [1]	All graduates		All engineers [1]	All graduates		All engineers [1]	All graduates		All engineers [1]	All graduates
			1934 income (in dollars)														
69 years and over	Prior to 1889	46+	[2]	7,367	7,570	[3]	5,155	5,513	2,500	3,292	3,700	[3]	1,861	2,225	[2]	1,050	1,229
61–68 years	1889–96	38–45	[2]	8,460	9,372	[3]	5,700	6,264	2,200	3,793	4,280	[3]	2,294	2,625	[2]	1,105	1,160
53–60 years	1897–1904	30–37	7,848	7,951	8,548	4,147	5,443	5,841	2,523	3,745	4,095	1,305	2,520	2,751	631	1,558	1,711
45–52 years	1905–12	22–29	9,171	7,230	7,665	5,426	4,980	5,271	3,040	3,524	3,788	1,579	2,526	2,688	921	1,826	1,893
41–44 years	1913–16	18–21	7,293	6,221	6,542	4,576	4,518	4,863	2,892	3,319	3,540	1,667	2,471	2,655	1,042	1,829	1,966
37–40 years	1917–20	14–17	5,560	5,393	5,656	3,667	4,058	4,278	2,414	3,101	3,271	1,514	2,379	2,525	848	1,839	1,960
33–36 years	1921–24	10–13	4,101	4,323	4,405	3,055	3,387	3,499	1,992	2,676	2,801	1,276	2,113	2,219	694	1,625	1,752
31–32 years	1925–26	8–9	3,560	3,554	3,601	2,468	2,892	2,949	1,700	2,380	2,442	1,123	1,929	2,002	526	1,513	1,581
29–30 years	1927–28	6–7	2,658	3,066	3,120	2,028	2,507	2,533	1,439	2,106	2,141	1,015	1,745	1,806	500	1,298	1,362
28 years	1929	5	2,209	2,635	2,658	1,764	2,209	2,227	1,296	1,929	1,946	934	1,593	1,621	431	1,244	1,266
27 years	1930	4	2,149	2,370	2,371	1,621	2,044	2,044	1,224	1,789	1,797	889	1,431	1,443	408	1,083	1,093
26 years	1931	3	2,028	2,155	2,146	1,536	1,900	1,895	1,171	1,578	1,571	835	1,265	1,261	352	954	949
25 years	1932	2	1,793	2,002	1,999	1,442	1,701	1,693	1,113	1,396	1,392	815	1,107	1,104	336	837	835
24 years	1933	1	1,664	1,911	1,895	1,325	1,562	1,551	991	1,272	1,265	606	960	954	242	528	520
23 years	1934	0	1,388	1,391	1,311	1,093	976	939	744	642	617	372	321	309	149	128	123

[1] Includes all graduates and all "other" engineers.
[2] Between 50 and 100 engineers reported.
[3] Between 10 and 50 engineers reported.

Caution should be exercised in comparing earnings with various types of employment in 1929, 1932, and 1934. The earnings of all engineers in engineering work reflect best the changes in what was being paid for engineering services. Both sets of figures of engineering earnings do reflect changes in the rates for given kinds and qualities of work. This is not true of the earnings from nonengineering; they indicate merely what individual engineers were able to earn in miscellaneous employments called "nonengineering." Conceivably such persons might all have been managers of industrial establishments in 1929 and gasoline-station attendants in 1932. Obviously a decrease in earnings from nonengineering employment would not then measure the fall in earnings of industrial managers. Actually the changes reflect the composite effect of a lowering of pay for various types of nonengineering work and a lowering of the quality of nonengineering work that was accepted as an alternative to unemployment.

Finally, among those reported at the end of the year as engaged in both engineering and nonengineering, there were some who suffered unemployment during part of the year. Inasmuch as unemployment was far more common in 1932 and 1934 than in 1929, this accounts for part of the decreases in annual incomes previously noted for both engineering and nonengineering. As regards engineering, rate change alone will be more fully analyzed later when monthly earnings from engineering employment are presented.[10]

Incomes from Engineering and Nonengineering Work

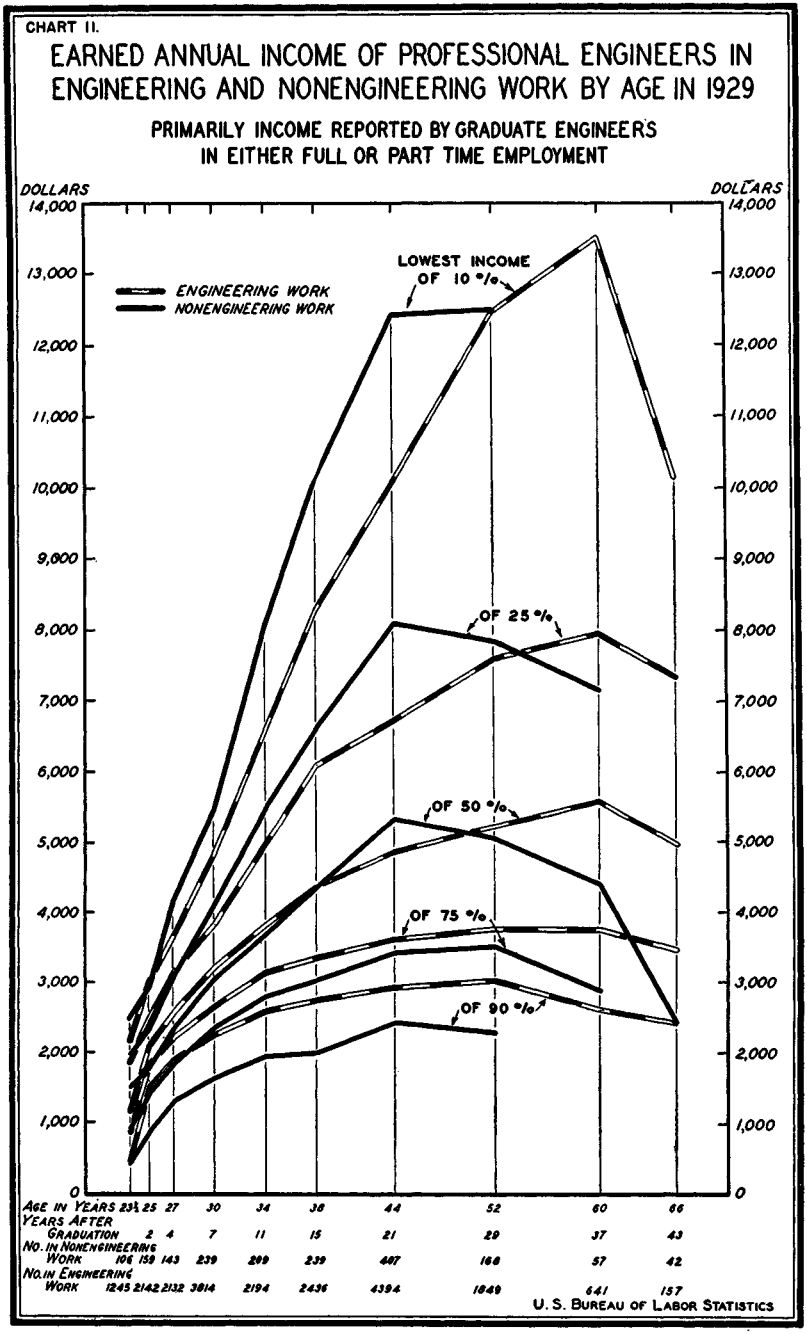
The first significant point of comparison between the incomes in 1929 of engineers engaged in engineering and those in nonengineering work is that the earnings of the latter showed greater dispersion. Thus, among engineers 40 to 47 years of age, 10 percent of those engaged in nonengineering earned more than $12,424 and 10 percent earned less than $2,420 per year. The respective annual incomes for similar proportions of all those in engineering work were $9,815 and $2,705; and of graduates in engineering $10,088 and $2,936. It seems apparent from these figures and others for 1929, that on the one hand many engineers were attracted out of engineering jobs by favorable opportunities, whereas, on the other hand, an almost equally large proportion dropped out of engineering work and were forced to find alternative employment. This point appears to be substantiated by a consideration of the variation in the relationship between engineering and nonengineering earnings in moving from the lowest to the highest of the 5 income levels. (Chart 11.)

[10] In the present chapter it must be borne in mind that the influence of unemployment in decreasing annual income was probably somewhat more important among those who reported nonengineering work as the source of income. It has been stated that the major direction of flow was from engineering work into nonengineering work. While some such transfers were made without an intervening period of unemployment, there must have been unemployment for many who lost engineering jobs and went into nonengineering work after failure to find work of an engineering nature.

Only at the lowest 10-percent income group or level did engineering incomes exceed those from nonengineering work at all ages for which comparison can be made. At the middle levels the engineering incomes were greater than nonengineering by only 10 percent at 25 and 27 years of age, and by only 5 percent at age 30. From this point the more rapid advance in average nonengineering earnings to a maximum at age 44 brought about an equalization of the incomes near to age 34 at a value of $3,700 per year. They again equalized at 54 years. That is, between 44 and 54 years, while the average returns from nonengineering had declined from $5,346 to $4,900, those from engineering had advanced from $4,562 to $4,900. The advance in the latter continued to age 60, attaining a value of $4,979 per year, as against $4,400 for nonengineering at the same age. At the upper 10- and 25-percent income groups or levels, engineering work ceased to have an advantage over nonengineering near to age 26. Thereafter the latter diverged upwards from the former to reach a maximum of $12,495 at age 52 at the highest level, and of $8,106 at age 44 in the case of the next lowest level. The corresponding values of engineering earnings were $11,709 and $6,407 per annum. The steady advance in engineering earnings, together with the declines in nonengineering earnings brought about an equalization of incomes at age 58.

A second point of significance is that, in 1929, engineering work as such ultimately offered rewards as high as engineers were able to find in nonengineering. This arose primarily from the fact that the age of maximum earning power arrived more quickly for engineers in nonengineering than in engineering work. For at 48 to 55 years of age those college graduates who stayed in engineering were doing proportionately as well as those who had gone into nonengineering. This was true even at the highest income levels. The earnings of the upper 10 percent of the college graduates continued to advance from $10,088 at age 44 to $13,516 at 60. The average at these ages rose from $4,876 to $5,590, whereas the average from nonengineering fell from $5,346 to $4,400 between these ages.

From the preceding analysis, therefore, it appears that in 1929 the tendency was for average annual incomes of engineers who engaged in nonengineering work to exceed slightly those from engineering work. Notwithstanding, it should be noted that the opportunities outside the engineering field did not embrace more than 7 percent of the total reporting in any one age classification. Furthermore, since there is no knowledge of the basis of selection, it cannot be said that nonengineering earnings would have been greater or less for the engineer had he stayed in engineering work. The only justifiable assumption is that in 1929 there was a preference to remain in engineering by those in the two lower income groups or levels and a definite tendency to accept attractive openings in nonengineering work at the two



higher income levels. The turning point in this movement occurred near to the middle levels of income reported.

Changes in Income, 1929 to 1934

Earlier in this chapter the changes from 1929 to 1934 in the incomes of all engineers were analyzed on an age basis. The decreases noted were due partly to salary reductions on given jobs. They were also due to the fact that incomes were reduced by extended periods of unemployment and by the necessity for accepting poorer jobs. The purpose of the earlier discussion was to determine, for example, what happened between 1929 and 1934, on the average, to engineers 40 to 47 years of age.

From the data presented in table 58 it is now possible to trace more precisely the influence of these several factors on the incomes of engineers. The first point to be noted is that the relationship changed between the jobs that engineers took in engineering and nonengineering work. In 1929 the essential elements of the story are to be found in the similarities of earnings in the two fields, rather than in the differences. On the whole it appears that nonengineering work was an alternative to engineering work. But from 1929 to 1934 many nonengineering jobs were accepted as an alternative to unemployment or work relief. Thus, the average earnings of those who were 40 to 47 years of age in 1929 and were in nonengineering work were $5,346. In 1934 a larger number of men from this age class were in nonengineering, and the average of this larger group was $3,040, a decline of 43 percent. By way of contrast the average annual income of graduates in engineering work of from 40 to 47 years of age was $4,876 in 1929. A smaller number still in engineering in 1934 averaged $3,788, a decrease of only 23 percent.

The extent to which earnings opportunities from nonengineering work depreciated between 1929 and 1934 differed at the various age levels. The average earnings of two groups in nonengineering whose ages were 28 to 40 in 1929 declined by almost one-third from 1929 to 1934. As between the groups of those who were over 48 in 1929, the average income of the 1934 group was only half the average of the 1929 group. Similarly at each of the other income levels there was a greater fall in the average income of older men in nonengineering.

Those who were able to stay in engineering fared better. As illustrating this point, table 59 is presented, covering graduates of

TABLE 59.—*Comparison of 5 levels of annual earnings in 1929, 1932, and 1934 from engineering work, of 5 age groups of older graduates* [1] *reporting*

Percentage at specified income level	Annual earnings of more than specified amount of engineers whose ages were—											
	60 in 1929	63 in 1932	65 in 1934	38 in 1929	41 in 1932	43 in 1934	30 in 1929	33 in 1932	35 in 1934	25 in 1929	28 in 1932	30 in 1934
10 percent	$13,516	$9,643	$9,372	$8,294	$6,700	$6.542	$4,842	$4,415	$4,405	$2,992	$3,021	$3,120
25 percent	7,955	6,589	6,264	6,099	4,990	4,863	3,847	3,546	3,499	2,477	2,521	2,533
50 percent	5,590	4,689	4,280	4,353	3,711	3,540	3,207	2,885	2,801	2,095	2,128	2,141
75 percent	3,760	3,143	2,625	3,354	2,854	2,655	2,664	2,299	2,219	1,831	1,751	1,806
90 percent	2,624	1,571	1,160	2,756	2,090	1,966	2,258	1,728	1,752	1,443	1,310	1,362
	Percentage increase or decrease											
	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34
10 percent	−31	−29	−3	−21	−19	−2	−9	−9	(2)	+4	+1	+3
25 percent	−21	−17	−5	−20	−18	−3	−9	−8	−1	+2	+2	(2)
50 percent	−23	−16	−9	−19	−15	−5	−13	−10	−3	+2	+2	+1
75 percent	−30	−16	−16	−21	−15	−7	−17	−14	−3	−1	−4	+3
90 percent	−56	−40	−26	−29	−24	−6	−23	−24	+1	−9	+12	+4

[1] Includes postgraduates, nonengineering graduates, and first-degree engineering graduates who reported they were professionally active prior to 1930.
[2] Less than 1 percent.

advancing age and experience, who were engaged in engineering work. A similar table based on the data in table 58 might be presented for all engineers. Essentially, however, the changes which occurred in the earnings from engineering work, as reported by all engineers and by graduates only, were consistently uniform.

In the period from 1929 to 1934 the average earnings of graduates in engineering who were 60 years old in 1929 declined 23 percent. There was a smaller decrease for the middle-aged groups, and among those averaging 30 years of age in 1929 the decline amounted to 13 percent. For the youngest groups shown in the table—those who were 25 in 1929 and 30 in 1934—the 5 years of added experience resulted in an actual increase in the average earnings of those who remained in engineering in 1934, as against the average for the larger numbers in the profession in 1929. The nature and extent of these changes in the averages of graduate earnings from engineering work were closely paralleled by those which occurred at the two upper income groups or levels. The increase in average earnings that was noted at 25 and 30 years did not occur for this age group at the two lower levels of income for the period 1929 to 1934. Furthermore, the declines in earnings for the lowest 10 percent in each of the three older groups were greater than the average.

The relative changes as between nonengineering earnings and those for engineering work of engineers with advancing age and experience are also found to be the same for men with comparable periods of experience (table 60).

TABLE 60.—*Comparison of 5 levels of annual earnings in 1929, 1932, and 1934 from nonengineering and engineering work, for corresponding years after graduation*

Age of engineers	Years after graduation	Proportion with annual earnings of more than specified amount														
		10 percent			25 percent			50 percent			75 percent			90 percent		
		1929	1932	1934	1929	1932	1934	1929	1932	1934	1929	1932	1934	1929	1932	1934
Nonengineering work—all engineers:																
23½ years	½	$2,496	$1,689	$1,388	$1,973	$1,240	$1,093	$1,500	$814	$744	$936	$406	$372	$446	$163	$149
25 years	2	2,910	1,850	1,710	2,344	1,380	1,365	1,786	990	1,040	1,407	520	685	889	210	275
28 years	5	4,560	2,463	2,160	3,320	1,908	1,680	2,525	1,319	1,250	1,995	765	910	1,410	306	420
33 years	10	7,320	4,290	3,770	5,060	3,007	2,640	3,500	1,963	1,790	2,670	1,123	1,170	1,840	490	575
43 years	20	11,950	7,950	7,293	7,780	5,140	4,576	5,100	2,880	2,892	3,390	1,580	1,667	2,340	785	1,042
53 years	30	(1)	9,130	8,400	7,730	5,200	4,770	4,970	3,050	2,775	3,420	1,425	1,435	(1)	570	760
60 years	37	(1)	(1)	(1)	7,155	5,020	(2)	4,400	2,725	2,400	2,893	1,270	(2)	(1)	(1)	(1)
Engineering work—all engineers:																
23½ years	½	2,356	1,910	1,391	1,933	1,335	976	1,322	766	642	888	383	321	502	153	128
25 years	2	3,043	2,100	1,960	2,501	1,840	1,610	2,105	1,520	1,310	1,834	1,150	1,020	1,476	690	650
28 years	5	3,910	3,005	2,470	3,320	2,504	2,115	2,750	2,103	1,840	2,280	1,702	1,490	1,940	1,257	1,150
33 years	10	5,940	4,332	3,800	4,480	3,457	3,020	3,520	2,790	2,470	2,890	2,195	2,000	2,385	1,619	1,550
43 years	20	9,400	6,660	6,221	6,250	4,800	4,518	4,440	3,580	3,319	3,400	2,660	2,471	2,690	1,920	1,829
53 years	30	11,900	8,230	7,620	7,060	5,640	5,180	4,900	3,990	3,620	3,460	2,790	2,530	2,650	1,840	1,680
60 years	37	12,625	8,800	8,150	7,500	6,130	5,550	4,979	4,070	3,750	3,422	2,710	2,440	2,420	1,470	1,370
Engineering work—graduates only:																
23½ years	½	2,165	1,826	1,311	1,858	1,243	939	1,168	716	617	862	358	309	449	143	123
25 years	2	2,992	2,100	1,940	2,477	1,840	1,610	2,095	1,510	1,310	1,831	1,150	1,015	1,493	690	650
28 years	5	4,030	3,021	2,470	3,360	2,521	2,110	2,800	2,128	1,840	2,375	1,751	1,505	2,010	1,310	1,170
33 years	10	6,100	4,415	3,860	4,660	3,546	3,110	3,680	2,885	2,530	3,040	2,299	2,110	2,495	1,728	1,640
43 years	20	10,350	7,100	6,542	6,620	5,140	4,863	4,770	3,865	3,540	3,600	2,890	2,655	2,910	2,060	1,966
53 years	30	12,500	8,820	8,100	7,620	5,980	5,560	5,270	4,320	3,910	3,780	3,030	2,710	2,960	1,980	1,790
60 years	37	13,516	9,400	8,850	7,955	6,400	5,980	5,590	4,580	4,150	3,760	3,080	2,690	2,624	1,710	1,460

		Percentage increase or decrease														
		1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34
Nonengineering work—all engineers:																
23½ years	½	−44	−32	−18	−45	−37	−12	−50	−46	−9						
25 years	2	−41	−36	−8	−42	−41	−1	−42	−45	+5	−51	−63	+32	−69	−76	+31
28 years	5	−53	−46	−12	−48	−43	−12	−50	−48	−5	−54	−62	+19	−70	−78	+37
33 years	10	−48	−41	−12	−50	−41	−16	−49	−44	−9	−56	−58	+4	−69	−73	+17
43 years	20	−39	−33	−8	−41	−34	−11	−43	−44	[3]	−51	−53	+6	−55	−66	+33
53 years	30			−8	−38	−33	−8	−44	−39	−9	−58	−58	+1			+33
60 years	37					−30		−45	−38	−12		−56				
Engineering work—all engineers:																
23½ years	½	−41	−19	−27	−50	−31	−27	−51	−42	−16						
25 years	2	−36	−31	−7	−36	−26	−13	−38	−28	−14	−44	−37	−11	−56	−53	−6
28 years	5	−37	−23	−18	−36	−25	−16	−33	−24	−13	−35	−25	−12	−41	−35	−9
33 years	10	−36	−27	−12	−33	−23	−13	−30	−21	−11	−31	−24	−9	−35	−32	−4
43 years	20	−34	−29	−7	−28	−23	−6	−25	−19	−7	−27	−22	−7	−32	−29	−5
53 years	30	−36	−31	−7	−27	−20	−8	−26	−19	−9	−27	−19	−9	−37	−31	−9
60 years	37	−35	−30	−7	−26	−18	−9	−25	−18	−8	−29	−21	−10	−43	−39	−7
Engineering work—graduates only:																
23½ years	½	−39	−16	−28	−49	−33	−24	−47	−39	−14						
25 years	2	−35	−30	−8	−35	−26	−13	−37	−28	−13	−45	−37	−12	−56	−54	−6
28 years	5	−39	−25	−18	−37	−25	−16	−34	−24	−14	−37	−26	−14	−42	−35	−11
33 years	10	−37	−28	−13	−33	−24	−12	−31	−22	−12	−31	−24	−8	−34	−31	−5
43 years	20	−37	−31	−8	−27	−22	−5	−26	−19	−8	−26	−20	−8	−32	−29	−5
53 years	30	−35	−29	−8	−27	−22	−7	−26	−18	−9	−28	−20	−11	−40	−33	−10
60 years	37	−35	−30	−6	−25	−20	−7	−26	−18	−9	−28	−18	−13	−44	−35	−15

[1] Between 50 and 100 engineers reported.

[2] Between 10 and 50 engineers reported.

[3] Less than 1 percent.

As far as the comparison of nonengineering and engineering earnings is concerned, this table merely reenforces the evidence already advanced as to the severe fall of income that occurred when engineers were forced out of the profession. However, the table sets forth more clearly than table 59 the picture of the fall of earnings from engineering. It was among those newcomers who were trying to force their way into the profession that the greatest fall of income occurred. Thus, average earnings in engineering in 1934, 2 years after graduation, were 37 percent less than in 1929. The earnings of those who had been out of college 10 years were 31 percent lower in 1934 than in 1929. At higher ages all groups averaged a decrease of 26 percent. A similar movement occurred in the level of earnings of the upper and lower 25 percent of those in engineering, but at the level of the upper 10 percent the declines were greater for the older engineers.

Incomes of Unemployed Engineers

In 1934 almost one-tenth of the reporting engineers were unemployed or on work relief at the end of the year. The low level of earnings of this group during 1934 contributed to lowering the average earnings of all engineers (table 61.)

The distribution of the earnings of this group has significance only as indicating the income which a group, unemployed in December 1934, had earned in the preceding 12 months. Some were probably men who had a few months' work at a good rate, and a long period of unemployment. Others may have worked quite steadily at a low rate and become recently unemployed. All were unemployed at the end of the year. They could look back on average earnings for the preceding 12 months of $700 to $950 if they were less than age 28, while those of 40 to 50 had averaged $1,350. Only about 10 percent of the unemployed, even though they were in those ages at which engineering earnings reach a peak, had made as much as $2,000 in the preceding 12 months. Ten percent had made less than $300 a year.

TABLE 61.—*Comparison of 5 levels of annual earnings in 1932 and 1934 of all engineers reporting unemployment, by age*

[Without regard to type of education]

Age	Year of graduation	Years after graduation	Proportion earning more than specified amount				
			10 percent	25 percent	50 percent	75 percent	90 percent
			1932 income				
67 years and over	Prior to 1889	44 and over	(1)	(1)	(1)	(1)	(1)
59–66 years	1889–96	36–43	(2)	(2)	$720	(2)	(2)
51–58 years	1897–1904	28–35	$2,453	$1,477	793	$396	$159
43–50 years	1905–12	20–27	2,790	1,867	1,105	528	211
39–42 years	1913–16	16–19	2,497	1,574	1,008	494	198
35–38 years	1917–20	12–15	2,420	1,417	1,057	559	223
31–34 years	1921–24	8–11	2,150	1,416	932	462	185
29–30 years	1925–26	6–7	1,754	1,250	761	380	152
27–28 years	1927–28	4–5	1,690	1,178	751	375	150
26 years	1929	3	1,232	925	605	303	121
25 years	1930	2	1,280	907	581	290	116
24 years	1931	1	1,233	891	588	294	118
20–23 years	1932	0	(3)	754	503	251	(3)
			1934 income				
69 years and over	Prior to 1889	46 and over	(2)	(2)	$1,000	(2)	(2)
61–68 years	1889–96	38–45	(3)	$1,300	688	$344	(3)
53–60 years	1897–1904	30–37	$2,349	1,700	1,080	542	$217
45–52 years	1905–12	22–29	2,546	1,943	1,357	748	299
41–44 years	1913–16	18–21	2,151	1,730	1,357	867	353
37–40 years	1917–20	14–17	2,250	1,780	1,316	769	308
33–36 years	1921–24	10–13	1,959	1,634	1,304	836	340
31–32 years	1925–26	8–9	2,138	1,746	1,243	716	287
29–30 years	1927–28	6–7	1,796	1,495	1,045	546	219
28 years	1929	5	1,805	1,417	893	449	180
27 years	1930	4	1,638	1,374	948	534	214
26 years	1931	3	1,545	1,210	836	419	167
25 years	1932	2	1,548	1,200	716	358	143
24 years	1933	1	1,460	1,107	756	378	151
20–23 years	1934	0	1,257	881	571	285	114

[1] Fewer than 10 persons reported.
[2] Between 10 and 50 persons reported.
[3] Between 50 and 100 persons reported.

Chapter IX

Monthly Earnings of Professional Engineers, 1929 to 1934

In the preceding discussion of earned annual incomes it was necessary to assume that the kind of engineering employment reported at the end of 1929, 1932, or 1934 was the source of the earnings throughout that year. As regards the six distinct analyses of monthly rates presented in this chapter, there should be virtually no inconsistency between the source reported and the earnings, primarily because, unlike earned annual incomes, the monthly rates at which engineering services were purchased are not affected by periods of partial or complete unemployment during the year.

Engineering Earnings Without Regard to Kind of Engineering Employment in 1929, 1932, and 1934

Earnings of All Engineers Combined Without Regard to Age

Of the 33,266 engineers 23 years of age and more who reported as of December 31, 1929, that they were professionally active prior to 1930, 28,511, or 85 percent, stated their average monthly rates for the engineering work in which they were engaged. These 1929 data, together with the adjusted figures for 1932 and 1934, are shown in table 62, without regard to age or kind of engineering employment reported.

TABLE 62.—*Comparison of 5 levels of monthly engineering earnings in 1929, 1932, and 1934 of all professional engineers reporting*

[Figures adjusted as explained on p. 34 and without regard to kind of engineering employment reported or type of education]

Percentage at specified earnings level	Monthly engineering earnings of more than specified amount			Amount of decrease			Percentage decrease		
	1929	1932	1934	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34
10 percent	$609	$484	$435	$174	$125	$49	28.6	20.5	10.1
25 percent	415	334	304	111	81	30	26.7	19.5	9.0
50 percent	289	235	210	79	54	25	27.3	18.7	10 6
75 percent	215	167	148	67	48	19	31.2	22.3	11.4
90 percent	162	123	112	50	39	11	30.9	24.1	8.9

As in the case of earned annual incomes, the range in the 1929 monthly engineering earnings of professional engineers was very great. While some 79 engineers reported earnings of less than $60 per month,

168 earned more than $1,880 a month. The median monthly earnings of the 28,511 reporting engineers was $289; one-quarter earned more than $415; and only 10 percent had earnings greater than $609 a month. The lowest 25 percent of the reporting engineers earned less than $215 a month, while the lowest 10 percent earned less than $162 a month.

Over the period 1929–34, the changes which occurred in monthly engineering earnings were similar to those previously noted in the discussion of earned annual incomes: (1) Earnings progressively declined from 1929 to 1934; (2) almost two-thirds of the decreases occurred between 1929 and 1932; (3) the sharpest absolute decreases occurred at the higher levels of earnings, but the greatest percentage decreases took place at the two lower income levels.

The changes in monthly engineering earnings were very much less than those for earned annual incomes. This is due to the fact that annual earnings reflect the combined effects of several factors which were operative in the depression years: (1) The decline in engineering earnings; (2) the acute unemployment; and (3) the deterioration in the nature of the available nonengineering work. Furthermore, the fact that there were a large number of engineering graduates in 1930–34, of whom a large number were unable to find engineering employment, probably acted further to cause a greater drop in annual incomes than in rates for engineering services.

Clearly, earned annual income data cannot be used as a measure of the rates at which engineering services were purchased. Illustrative of this is the fact that in 1929 only at the two higher earnings levels did earned annual income exceed 12 times the monthly earnings reported solely from engineering services.[1] In the years 1932 and 1934 the difference between 12 times the monthly engineering income alone and the reported annual income from all services was more marked than in 1929. At each earnings level it showed rates of earnings higher than realized income. The discrepancy is of course greatest at the lower levels. Thus, 10 percent of the reporting engineers actually earned less than $872 in 1934. This group included many who were unemployed, on work relief, or in makeshift nonengineering jobs. On the other hand, among those who had engineering jobs at the end of 1934, the lowest 10 percent were paid at the rate of $112 a month or $1,344 a year. This was a decline of 30.9 percent subsequent to 1929. By contrast, the earned annual incomes of a similar proportion of engineers had declined by 53.6 percent. At the next highest income level, engineering earnings decreased by 31.2 percent, as against 41.3 percent in the case of earned annual incomes. The differences between the decline in monthly

[1] This relationship is reasonable because in 1929 the earnings of those in nonengineering work were greater than the earnings of those in engineering.

rates for engineering work and in annual earnings of all engineers were less marked at the average level and at the two higher levels. Thus, on the average engineering rates declined 27.3 percent, whereas annual incomes declined by 33.0 percent.

It follows from this discussion that there is an important distinction between movements at the various levels of earned annual incomes and of engineering rates. Earned annual incomes among the upper 10 percent declined 31.2 percent; among the lower 10 percent, heavily weighted in 1934 with engineers who had been unemployed, by 53.6 percent. Engineering rates also declined more at the lower levels than at the upper levels. By and large, and especially by contrast with the movement of annual earnings, however, the impression given by the figures is of a fairly uniform decrease in rates of earnings at all levels. Thus, the monthly rates for the upper 10 percent of those engaged in engineering work declined 28.6 percent, while for the lower 10 percent they declined 30.9 percent.

Earnings by Professional Class, Without Regard to Age

The findings and comments of the preceding analysis also apply to the engineering earnings reported by the five professional classes. These are shown, also without regard to age [2] or kind of engineering employment, in table 63.

In 1929 there were several marked differences in the relationship of monthly rates for the various professional groups at the higher and lower levels. Mining and metallurgical engineers received more than the other professional groups. The upper 10 percent of mining and metallurgical engineers had earnings of not less than $792 per month. Second in order came chemical and ceramic engineers, of whom the upper 10 percent had monthly earnings of not less than $732, followed by mechanical and industrial engineers, and electrical engineers, respectively, with not less than $674 and $587 a month. At this level, civil engineers received the lowest rates, $515 per month. For the upper 25 percent of the reporting engineers the order of the professional classes was the same, monthly earnings ranging from not less than $372 for civil engineers to not less than $503 a month for mining and metallurgical engineers. At the lower levels as well the mining and metallurgical rates of pay were greater than the rates for corresponding proportions of the other professional classes. But the relationships between the other classes are altered. At the two highest levels electrical engineers were in fourth place; at the middle and two lowest levels the rates for electrical engineers were less than those for

[2] It is important to note that any data concerning the several professional classes as a whole without regard to age tend to obscure the effects of different age distributions within the classes. Those classes with a relatively high proportion of older men for this reason are likely to show relatively high earnings, and those with relatively more younger men to show smaller earnings.

any of the other professional groups. Civil engineers rose to fourth place as regards average earnings, and to second place as regards the rates received by the lowest 10 percent in the various professional groups. And while chemical and ceramic engineers continued at the average level to be the second-best paid of the professional groups, they shifted to fourth place as regards the level of earnings for the lowest 10 percent.

TABLE **63.**—*Comparison of 5 levels of monthly engineering earnings in 1929, 1932, and 1934 of all engineers reporting, by professional class*

[Figures adjusted as explained on p. 34 and without regard to kind of engineering employment reported or type of education]

Percent of professional class at specified earnings level [1]	Monthly engineering earnings of more than specified amount			Amount of decrease			Percentage decrease		
	1929	1932	1934	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34
10 percent:									
Mining and metallurgical	$792	$585	$524	$268	$207	$61	33.8	26.1	10.4
Chemical and ceramic	732	579	509	223	153	70	30.5	20.9	12.1
Mechanical and industrial	674	512	441	233	162	71	34.6	24.0	13.9
Electrical	587	496	463	124	91	33	21.1	15.5	6.7
Civil, agricultural, and architectural	515	430	390	125	85	40	24.3	16.5	9.3
25 percent:									
Mining and metallurigcal	503	409	371	132	94	38	26.2	18.7	9.3
Chemical and ceramic	490	400	339	151	90	61	30.8	18.4	15.2
Mechanical and industrial	455	356	313	142	99	43	31.2	21.8	12.1
Electrical	405	336	315	90	69	21	22.2	17.0	6.2
Civil, agricultural, and architectural	372	311	279	93	61	32	25.0	16.4	10.3
50 percent:									
Mining and metallurgical	334	274	241	93	60	33	27.8	18.0	12.0
Chemical and ceramic	326	251	203	123	75	48	37.7	23.0	19.1
Mechanical and industrial	311	246	215	96	65	31	30.9	20.9	12.6
Civil, agricultural, and architectural	277	229	205	72	48	24	26.0	17.3	10.5
Electrical	275	232	215	60	43	17	21.8	15.6	7.3
75 percent:									
Mining and metallurgical	241	183	154	87	58	29	36.1	24.1	15.8
Mechanical and industrial	225	166	145	80	59	21	35.6	26.2	12.7
Chemical and ceramic	221	157	131	90	64	26	40.7	29.0	16.6
Civil, agricultural, and architectural	213	169	150	63	44	19	29.6	20.7	11.2
Electrical	201	163	148	53	38	15	26.4	18.9	9.2
90 percent:									
Mining and metallurgical	186	125	115	71	61	10	38.2	32.8	8.0
Civil, agricultural, and architectural	167	126	120	47	41	6	28.1	24.6	4.8
Mechanical and industrial	167	122	107	60	45	15	35.9	26.9	12.3
Chemical and ceramic	156	116	101	55	40	15	35.3	25.6	12.9
Electrical	148	123	108	40	25	15	27.0	16.9	12.2

[1] Arranged in ascending order of monthly engineering earnings for 1929.

While there were shifts in the order of the various professions as between different levels of earnings in 1929, the spread was less marked at the lower levels. Thus, among the lowest 10 percent of the various groups the range was from $148 per month for electrical engineers to $186 for mining and metallurgical, a range of not quite 26 percent. At the average level the absolute range was greater, from $275 to $334, but relatively it was a narrower range than was found at the

lowest level. However, at the levels of the highest 25 percent and the highest 10 percent in each class there was not only a greater absolute spread but also a greater relative difference among the several professional groups. Thus, the upper 10 percent of the mining and metallurgical en gineers, who were paid not less than $792 a month, received 54 percent more than the upper 10 percent of the civil engineers who received not less than $515.[3]

Despite the progressive declines in engineering earnings between 1929 and 1934, the orders of the professional classes at the two higher levels were essentially the same as those noted for 1929. However, at the middle earnings level, chemical and ceramic engineers had dropped from second place in 1929 and 1932 to fifth by 1934; but even in 1934 their monthly engineering earnings were practically the same as those of the civil engineers, who were fourth in order. Mining and metallurgical engineers were highest both in 1932 and 1934. Thus, in the latter year, while their median earnings were $241 a month, those of both mechanical and industrial engineers and electrical engineers were $215 a month.

At the lowest 25-percent earnings level of the reporting engineers, the lowest and highest figures for 1932 and 1934 were again reported, respectively, by chemical and ceramic engineers and mining and metallurgical engineers. At the same level in 1934 the range was from not more than $131 for chemical and ceramic engineers to not more than $154 for mining and metallurgical engineers. This reduction in the range of earnings was more pronounced at the lowest earnings level both in 1932 and 1934, for while in the former year it was from not more than $116 to not more than $126, in the latter it was from not more than $101 to not more than $120, the upper and lower extremes being reported, respectively, by the civil engineers and the chemical and ceramic engineers.

The decline in engineering earnings of each professional class was very much less than that which occurred in earned annual incomes. The greatest percentage decreases took place at the two lower levels. For example, while engineering earnings of electrical engineers at these limits declined by 26.4 and 27.0 percent, the corresponding annual incomes decreased by 42.6 and 56.0 percent. In the case of chemical and ceramic engineers, the drops in engineering earnings at these levels were 40.7 and 35.3 percent as against 52.2 and 63.8 percent in their annual income.

[3] It has been stated before, but can hardly be over-emphasized, that these levels of earnings need to be related to the number of those in the various professional groups. Thus, there were 12,920 civil engineers and 1,231 mining and metallurgical engineers in the 1929 sample under discussion. This means then, that 1,292 civil engineers earned more than $515 and 123 mining and metallurgical engineers earned more than $792. In absolute numbers there were more civil engineers (434) earning more than $792 monthly than there were mining and metallurgical engineers. Conversely, the highest paid 434 mining engineers (30.5 percent) of the total number earned approximately more than $427 per month.

Earnings Related to Age—All Engineers Combined

In table 64 there are presented the monthly engineering earnings, by age,[4] of all engineers combined and without regard to kind of engineering employment.

TABLE **64.**—*Comparison of 5 levels of monthly engineering earnings in 1929, 1932, and 1934 of all engineers reporting, by age*

[Without regard to kind of engineering employment reported or type or education]

Age	Year of graduation	Years after graduation	Proportion with monthly engineering earnings of more than specified amount				
			10 per-cent	25 per-cent	50 per-cent	75 per-cent	90 per-cent
			1929				
64 years and over	Prior to 1889	40 and over	$820	$601	$388	$263	$194
56–63 years	1889–96	33–40	1,050	628	425	296	210
48–55 years	1897–1904	25–32	933	592	414	297	232
40–47 years	1905–12	17–24	789	514	385	289	229
36–39 years	1913–16	13–16	630	467	339	269	218
32–35 years	1917–20	9–12	519	407	310	249	208
28–31 years	1921–24	5–8	404	317	262	217	187
26–27 years	1925–26	3–4	307	256	218	186	155
24–25 years	1927–28	1–2	252	215	181	152	133
23 years	1929	0	215	174	149	130	115
			1932				
67 years and over	Prior to 1889	44 and over	$725	$499	$331	$216	$144
59–66 years	1889–96	36–43	751	517	352	241	152
51–58 years	1897–1904	28–35	707	486	340	241	164
43–50 years	1905–12	20–27	624	433	315	234	168
39–42 years	1913–16	16–19	517	396	295	223	170
35–38 years	1917–20	12–15	458	349	272	211	157
31–34 years	1921–24	8–11	358	293	234	189	143
29–30 years	1925–26	6–7	299	244	205	166	135
27–28 years	1927–28	4–5	250	215	181	147	119
26 years	1929	3	221	185	156	134	110
25 years	1930	2	190	161	143	122	101
24 years	1931	1	173	149	126	104	84
23 years	1932	0	165	137	111	89	66
			1934				
69 years and over	Prior to 1889	46 and over	$620	$430	$284	$173	$108
61–68 years	1889–96	38–45	711	480	321	205	126
53–60 years	1897–1904	30–37	650	447	310	212	146
45–52 years	1905–12	22–29	592	413	292	214	152
41–44 years	1913–16	18–21	505	375	273	205	150
37–40 years	1917–20	14–17	440	336	254	197	148
33–36 years	1921–24	10–13	354	285	224	177	139
31–32 years	1925–26	8–9	299	238	199	161	133
29–30 years	1927–28	6–7	253	215	177	145	118
28 years	1929	5	228	191	162	138	113
27 years	1930	4	199	172	148	125	104
26 years	1931	3	182	156	137	114	94
25 years	1932	2	169	145	124	103	84
24 years	1933	1	159	138	116	98	82
23 years	1934	0	149	129	110	91	75

[4] Throughout the ensuing discussion, age and years after graduation are used interchangeably. Of course, in the case of nongraduates (i. e., "other" engineers) age only applies. The relationship between these 2 factors can readily be derived from the fact that the median age of graduation of new graduates to the profession was found to be 23 years.

As shown in the table there was, in general, a steady advance in monthly earnings at all levels up to the highest age groups. Except for the absence of the exceptionally rapid rise from 23 to 25 years, the changes with age in monthly engineering earnings at all 5 levels show no marked differences from those derived from the analysis of earned annual incomes by age. Thus, in 1929 the compensation for engineering services of the lowest tenth of the reporting engineers steadily increased from over $115 a month for those at age 23 to a maximum of over $232 a month for those who were between 48 and 55 years. At each of the four higher earnings levels maximum earnings were reached some 8 years later, or near to age 60. The respective maxima were not less than $297, $425, $628, and $1,050 per month.

The tables of monthly earnings by age are of especial importance because of the light they shed on the entrance rates of engineers. In the tables of annual incomes the graduating class of 1929 did not have an opportunity to earn for more than 6 months. Some engineers apparently did report an annual rate of earnings, rather than actual earnings in the year. In any event, however, it is not possible to present any useful contrasts between the earnings of men just out of college and those who had been out a year or more. In this section on monthly rates of earnings the progression from entrance rates of pay is clearly shown.

There is a marked spread in rates of pay at all ages. In 1929 the earnings of engineers 23 years of age, essentially beginners in the profession, averaged $149 a month. Above this one-quarter earned over $174, and one-tenth over $215 per month, as against monthly engineering earnings of over $130 and $115 at the two lower levels.

The spread in engineering earnings with advancing age became quite marked at the age of 30; that is, some 8 years earlier than was the case for earned annual incomes. (See chart 12.) Again the earnings of the upper 10 percent of reporting engineers diverged sharply from those at corresponding ages in the lower levels. Thus, at age 44 the former were greater than the average by some 102 percent, as against a corresponding difference at the upper 25-percent level of only 33 percent. At age 60, the respective differences were 144 and 48 percent.

These general relationships of monthly engineering earnings by age of all engineers [5] reporting, also held in the years 1932 and 1934, as well as for the monthly earnings of all graduates,[6] shown in table 65.

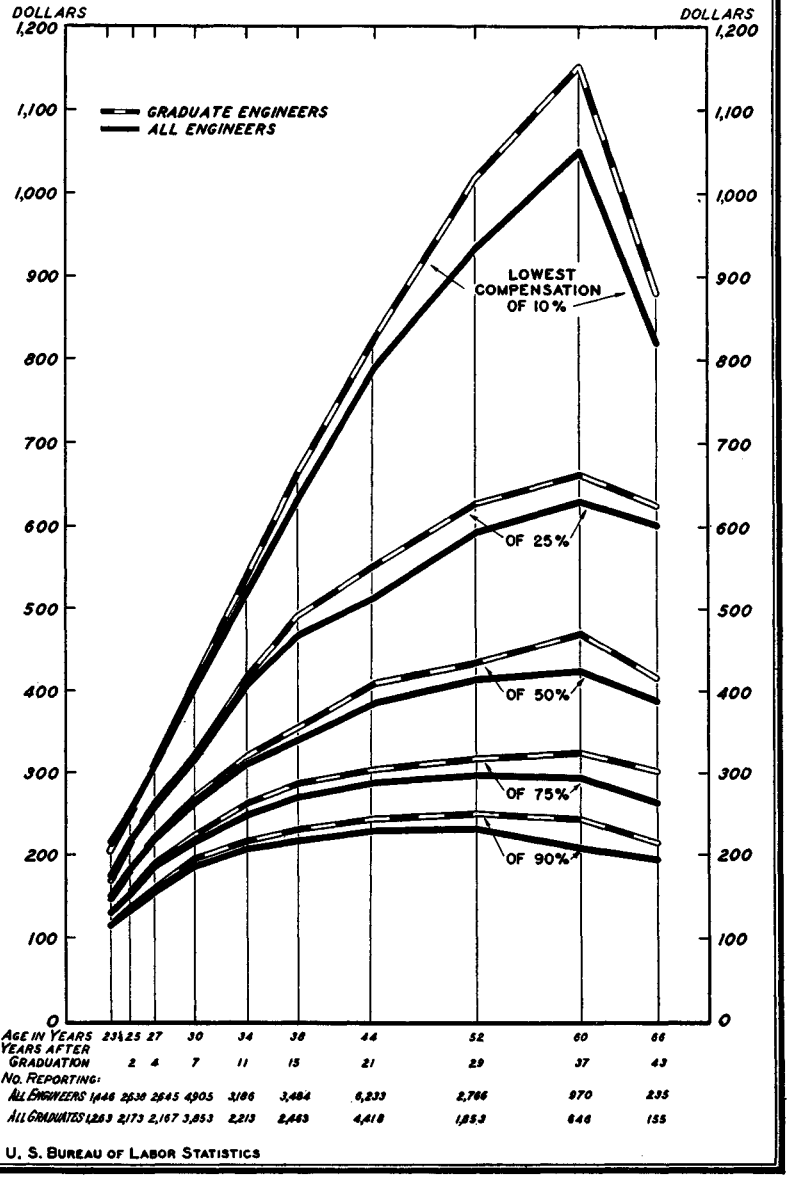
[5] Graduates and "other" engineers combined.

[6] Postgraduates, nonengineering graduates, and first-degree engineering graduates combined.

CHART 12

MONTHLY COMPENSATION OF PROFESSIONAL ENGINEERS IN ENGINEERING WORK BY AGE IN 1929

INCLUDES COMPENSATION FOR ALL KINDS OF ENGINEERING SERVICES REPORTED



AGE IN YEARS	23 & 25	27	30	34	38	44	52	60	66
YEARS AFTER GRADUATION	2	4	7	11	15	21	29	37	43
NO. REPORTING:									
ALL ENGINEERS	1,446	2,530	2,845	4,905	3,186	3,484	6,233	2,766	970	295
ALL GRADUATES	1,283	2,173	2,167	3,853	2,213	2,469	4,418	1,853	646	155

U. S. BUREAU OF LABOR STATISTICS

TABLE 65.—*Comparison of 5 levels of monthly engineering earnings in 1929, 1932, and 1934 of all graduate engineers reporting, by age*

[Without regard to kind of engineering employment reported or type of education]

Age	Year of graduation	Years after graduation	Proportion with monthly engineering earnings of more than specified amount				
			10 per-cent	25 per-cent	50 per-cent	75 per-cent	90 per-cent
			1929				
64 years and over	Prior to 1889	41 and over	$880	$624	$417	$302	$215
56–63 years	1889–96	33–40	1,152	661	472	326	243
48–55 years	1897–1904	25–32	1,018	625	434	319	252
40–47 years	1905–12	17–24	826	552	410	306	245
36–39 years	1913–16	13–16	663	490	356	286	231
32–35 years	1917–20	9–12	540	416	321	263	218
28–31 years	1921–24	5–8	410	322	269	223	196
26–27 years	1925–26	3–4	308	260	220	189	160
24–25 years	1927–28	1–2	247	213	180	152	135
23 years	1929	0	205	169	148	130	115
			1932				
67 years and over	Prior to 1889	44 and over	$778	$519	$350	$234	$173
59–66 years	1889–96	36–43	807	558	401	277	170
51–58 years	1897–1904	28–35	739	505	374	265	185
43–50 years	1905–12	20–27	653	458	334	248	178
39–42 years	1913–16	16–19	557	419	312	240	187
35–38 years	1917–20	12–15	480	365	288	223	171
31–34 years	1921–24	8–11	368	301	241	198	149
29–30 years	1925–26	6–7	302	251	210	172	141
27–28 years	1927–28	4–5	253	217	183	149	122
26 years	1929	3	219	184	156	135	113
25 years	1930	2	187	160	143	122	101
24 years	1931	1	171	148	125	104	84
23 years	1932	0	159	134	110	88	64
			1934				
69 years and over	Prior to 1889	46 and over	$636	$480	$307	$205	$110
61–68 years	1889–96	38–45	770	517	360	232	132
53–60 years	1897–1904	30–37	704	478	337	229	152
45–52 years	1905–12	22–29	626	431	313	226	158
41–44 years	1913–16	18–21	533	404	294	219	161
37–40 years	1917–20	14–17	461	354	271	210	157
33–36 years	1921–24	10–13	360	294	232	186	145
31–32 years	1925–26	8–9	303	242	205	169	140
29–30 years	1927–28	6–7	258	218	181	148	121
28 years	1929	5	228	192	164	140	115
27 years	1930	4	200	172	149	126	105
26 years	1931	3	180	156	137	114	94
25 years	1932	2	169	145	124	102	84
24 years	1933	1	159	137	116	98	82
23 years	1934	0	149	129	109	91	75

Consideration will now be given to the extent to which rates of pay for engineering work may have been affected by the depression. In this connection it must be noted, however, that the changes shown in the table underestimate the effective changes in rates. It is probably safe to assume that on the whole the less able engineers were laid off more frequently than the more able. If that were so, the average capacity of the 9,179 engineers who were 33 to 42 years of age in 1934 and were engaged on engineering work in 1934 was probably somewhat

greater than was that of the 8,210 engineers of these ages in 1929 engaged on engineering work in 1929. It follows that for $239 per month in 1934, the average for engineers 33 to 42, it was possible to hire a somewhat better qualified man than could have been hired for $338 in 1929. To this extent, the change in the averages understates the effective change in rates for engineering services.

Earnings of Engineers of Identical Ages

The average rates of earnings reported by men who were of identical ages in 1929, 1932, and 1934 are presented in tables 66 and 67. The general character of the results is not unlike that discussed under annual earnings. However, these tables make it possible for the first time to make a careful analysis of changes in the earnings of the engineers 23½ years of age, many of whom in 1929 tended to translate earnings for the first 6 months after graduation into an annual rate.[7]

TABLE 66.—*Comparison of 5 levels of monthly engineering earnings in 1929, 1932, and 1934 of all engineers, for corresponding years after graduation*

[Without regard to kind of engineering employment reported or type of education]

Age of engineers	Years after graduation	Proportion with monthly engineering earnings of more than specified amount														
		10 percent			25 percent			50 percent			75 percent			90 percent		
		1929	1932	1934	1929	1932	1934	1929	1932	1934	1929	1932	1934	1929	1932	1934
23½ years	½	$215	$165	$149	$174	$137	$129	$149	$111	$110	$130	$89	$91	$115	$66	$75
25 years	2	252	180	160	215	152	140	181	133	120	152	114	102	133	92	82
28 years	5	339	250	210	276	215	187	231	181	153	196	147	130	167	119	109
33 years	10	485	358	314	386	293	248	299	234	205	239	189	162	202	143	134
43 years	20	741	559	505	501	405	375	375	301	273	283	227	205	228	169	150
53 years	30	940	685	617	592	462	428	416	332	299	296	240	211	230	164	148
60 years	37	1,050	733	670	628	497	459	425	349	313	296	242	209	210	157	137
		Percentage increase or decrease														
		1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34
23½ years	½	−31	−23	−10	−26	−21	−6	−26	−6	−1	−30	−32	+2	−35	−43	+14
25 years	2	−37	−29	−11	−35	−29	−8	−34	−27	−10	−33	−25	−11	−38	−31	−11
28 years	5	−38	−26	−16	−32	−22	−13	−34	−22	−15	−34	−25	−12	−35	−29	−8
33 years	10	−35	−26	−12	−36	−24	−15	−31	−22	−12	−32	−21	−14	−34	−29	−6
43 years	20	−32	−25	−10	−25	−19	−7	−27	−20	−9	−28	−20	−10	−34	−26	−11
53 years	30	−34	−27	−10	−28	−22	−7	−28	−20	−10	−29	−19	−12	−36	−29	−10
60 years	37	−36	−30	−9	−27	−21	−8	−26	−18	−10	−29	−18	−14	−35	−25	−13

These data reveal the fact that the newcomers to the profession suffered less than those with from 2 to 5 years' experience in engineering. Thus, while median monthly earnings of the newcomers were 26 percent less in 1934 than those of men of similar ages in 1929, they were 34 percent less in the case of men with from 2 to 5 years' experience in each of these years. But it will also be noted that the declines

[7] This qualification applies only to graduate engineers, for in the case of "other" or nongraduate engineers many of them could have been working for a year or more.

in earnings of engineers between 1929 and 1934 with from 20 to 37 years of experience were practically the same as those reported by engineers 23½ years of age. Furthermore, a similar relationship existed at the four other earnings levels, despite the fact that the declines in earnings were relatively greater in the case of engineers at the two lower earnings levels.

TABLE 67.—*Comparison of 5 levels of monthly engineering earnings in 1929, 1932, and 1934 of all graduate engineers, for corresponding years after graduation*

[Without regard to kind of engineering employment reported or type of education]

Age of engineers	Years after graduation	Proportion with monthly engineering earnings of more than specified amount														
		10 percent			25 percent			50 percent			75 percent			90 percent		
		1929	1932	1934	1929	1932	1934	1929	1932	1934	1929	1932	1934	1929	1932	1934
23½ years	½	$205	$159	$149	$169	$134	$129	$148	$110	$109	$130	$88	$91	$115	$64	$75
25 years	2	247	180	161	213	153	140	180	132	119	152	112	100	135	93	82
28 years	5	339	253	210	280	217	184	238	183	155	199	149	132	170	122	110
33 years	10	500	368	320	389	301	260	309	241	212	252	198	174	211	149	132
43 years	20	797	583	533	539	428	404	400	320	294	301	241	219	243	181	161
53 years	30	1,030	715	664	628	497	451	440	365	326	320	260	228	253	182	156
60 years	37	1,152	780	729	661	539	489	472	394	348	326	271	230	243	175	146
		Percentage increase or decrease														
		1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34
23½ years	½	−27	−22	−6	−24	−21	−4	−26	−26	−1	−30	−32	+3	−35	−44	+17
25 years	2	−35	−27	−11	−34	−28	−8	−34	−27	−10	−34	−26	−11	−39	−31	−12
28 years	5	−38	−25	−17	−34	−23	−15	−35	−23	−15	−34	−25	−11	−35	−28	−10
33 years	10	−36	−26	−13	−33	−23	−14	−31	−22	−12	−31	−21	−12	−37	−29	−11
43 years	20	−33	−27	−9	−25	−21	−6	−27	−20	−8	−27	−20	−9	−34	−26	−11
53 years	30	−36	−31	−7	−28	−21	−9	−26	−17	−11	−29	−19	−12	−38	−28	−14
60 years	37	−37	−32	−7	−26	−18	−9	−26	−17	−12	−29	−17	−15	−40	−28	−17

It will be recalled that in the discussion of employment status, as far as available engineering work was concerned, the tendency appeared to be to give preference to engineers who entered the profession in the period 1930–34. The analysis of the data in table 66 shows that it was not those engineers who entered the profession in 1934 who suffered relatively the greatest cuts but those who had entered during one or other of the depression years, 1930–33, inclusive. Similar data for earnings of graduates of identical ages are shown in table 67.

Earnings in Relation to Advancing Age and Experience

In tables 68 and 69 the changes in earnings from 1929–34 are shown as they were affected not only by decreasing rates for a given type of work but also as they were influenced by advancing years and experience. Those engineers who were 23½ years in 1929 and 28½ in 1934 reported an increase in earnings from $149 to $162. At this level added experience counts heavily, as may be seen from the fact that in 1929, men with 5 years' experience averaged about $240. Those engineers who

entered the profession in 1929 were able to advance slightly even in the face of the depression. But it must not be overlooked that a large proportion of men 23½ years of age in 1929 were not engaged in engineering work in 1934.

TABLE 68.—*Comparison of 5 levels of monthly engineering earnings in 1929, 1932, and 1934 of 5 age groups of older [1] engineers reporting*

[Without regard to kind of engineering employment reported or type of education]

Percentage at specified income level	Monthly engineering earnings of more than specified amount of engineers whose ages were														
	60 in 1929	63 in 1932	65 in 1934	38 in 1929	41 in 1932	43 in 1934	30 in 1929	33 in 1932	35 in 1934	25 in 1929	28 in 1932	30 in 1934	23½ in 1929	26½ in 1932	28½ in 1934
10 percent	$1,050	$751	$711	$630	$517	$505	$404	$358	$354	$252	$250	$253	$215	$221	$228
25 percent	628	517	480	467	396	375	317	293	285	215	215	215	174	185	191
50 percent	425	352	321	339	295	273	262	234	224	181	181	177	149	156	162
75 percent	296	241	205	269	223	205	217	189	177	152	147	145	130	134	138
90 percent	210	152	126	218	170	150	187	143	139	133	119	118	115	110	113
	Percentage increase or decrease														
	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34
10 percent	−32	−28	−5	−20	−18	−2	−12	−11	−1	0	−1	+1	+6	+3	+3
25 percent	−24	−18	−7	−20	−15	−5	−10	−8	−3	0	0	0	+10	+6	+3
50 percent	−24	−17	−9	−19	−13	−7	−15	−11	−4	−2	0	−2	+9	+5	+4
75 percent	−31	−19	−15	−24	−17	−8	−18	−13	−6	−5	−3	−1	+6	+3	+3
90 percent	−40	−28	−17	−31	−22	−12	−26	−24	−3	−11	−11	−1	−2	−4	+3

[1] Includes those engineers who reported they were professionally active prior to 1930.

TABLE 69.—*Comparison of 5 levels of monthly engineering earnings in 1929, 1932, and 1934 of 5 age groups of older [1] graduate engineers reporting*

[Without regard to kind of engineering employment reported or type of education]

Percentage at specified income level	Monthly engineering earnings of more than specified amount of engineers whose ages were														
	60 in 1929	63 in 1932	65 in 1934	38 in 1929	41 in 1932	43 in 1934	30 in 1929	33 in 1932	35 in 1934	25 in 1929	28 in 1932	30 in 1934	23½ in 1929	26½ in 1932	28½ in 1934
10 percent	$1,152	$807	$770	$663	$557	$533	$410	$368	$360	$247	$253	$258	$205	$219	$228
25 percent	661	558	517	490	419	404	322	301	294	213	217	218	169	184	192
50 percent	472	401	360	356	312	294	269	241	232	180	183	181	148	156	164
75 percent	326	277	232	286	240	219	223	198	186	152	149	148	130	135	140
90 percent	243	170	132	231	187	161	196	149	145	135	122	121	115	113	115
	Percentage increase or decrease														
	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34
10 percent	−33	−30	−5	−20	−16	−4	−12	−10	−2	+4	+2	+2	+11	+7	+4
25 percent	−22	−16	−7	−18	−14	−4	−9	−7	−2	+2	+2	0	+14	+9	+4
50 percent	−24	−15	−10	−17	−12	−6	−14	−10	−4	+1	+2	−1	+11	+5	+5
75 percent	−29	−15	−16	−23	−16	−9	−17	−11	−6	−3	−2	−1	+8	+4	+4
90 percent	−46	−30	−22	−30	−19	−14	−26	−24	−3	−10	−10	−1	0	−2	+2

[1] Includes those engineers who reported they were professionally active to prior 1930.

Earnings of the next higher age group showed practically no change.

For succeeding age groups the declines in earnings were progressively greater. Thus, while there was a 15-percent decrease between 1929 and 1934 at the middle level of earnings of engineers who were 30 in 1929 and 35 in 1934, the decrease was as high as 24 percent for engineers who were 65 years of age in 1934. A similar situation existed at the other four earnings levels, for all engineers, and also for graduate engineers only, as shown in table 69.

Furthermore, it is to be noted that, among engineers up to 35 years of age in 1934, the earnings at the upper levels fell less than at the average. At all ages the greatest loss was at the lower levels.

Earnings and Education, Without Regard to Age

Of all engineers who furnished information on the monthly rates of compensation received by them for engineering services in 1929, 21,205 were graduates and 7,305 were "other" or nongraduate engineers. The former number represented 86 percent of the 24,837 graduates, and the latter covered 81 percent of the 9,015 "other" engineers who reported that they were professionally active prior to 1930. A comparison of the engineering earnings of these two groups is shown, without regard to age and kind of engineering employment reported, in table 70.

Although the figures in the third from the last column in table 70 indicate an advantage in favor of those men who have engineering degrees, this advantage is less clearly defined than was indicated in the similar analysis of earned annual incomes. This is evidenced by the fact that only at the highest earnings level did the earnings of graduates of all five professional classes exceed those of "other" engineers. Even at this level, the advantage did not accrue in equal measure for each of the five professional classes.

Thus, while the monthly earnings of the upper one-tenth of the mining and metallurgical graduates exceeded those of the upper tenth of the "other" or nongraduate engineers by $94 a month, the differences in monthly engineering earnings among the four remaining professional classes ranged from $31 for mechanical and industrial engineers to $61 for chemical and ceramic engineers. At the upper 25-percent level, the engineering earnings of mechanical and industrial graduates and "other" engineers were practically the same. There was a difference of only $13 between the earnings of the two groups in the case of mining and metallurgical engineers, and for electrical engineers the difference was only $22 a month. However, at this level, in the case of chemical and ceramic engineers and civil engineers the differences were much higher, being $61 and $62 per month, respectively.

At these two earnings levels, the relationships between the earnings of graduates and "other" or nongraduate engineers in 1932 and 1934 were similar to those just noted for 1929.

TABLE 70.—*Comparison of 5 levels of monthly engineering earnings in 1929, 1932, and 1934 of older [1] graduate and "other" engineers reporting, by professional class*

[Without regard to kind of engineering employment reported]

Percentage of professional class at specified earnings level [2]	Monthly engineering earnings of more than specified amount						Percentage earnings of "other" engineers formed of those of graduate engineers		
	Graduate engineers [3]			"Other engineers [4]					
	1929	1932	1934	1929	1932	1934	1929	1932	1934
10 percent:									
Mining and metallurgical	$803	$617	$612	$709	$501	$512	88	81	84
Chemical and ceramic	737	636	632	676	596	553	92	94	88
Mechanical and industrial	684	537	514	653	511	495	95	95	96
Electrical	594	516	505	557	504	482	94	98	95
Civil, agricultural, and architectural	544	463	427	478	385	352	88	83	82
25 percent:									
Mining and metallurgical	506	423	413	493	403	392	97	95	95
Chemical and ceramic	494	433	426	433	408	365	88	94	86
Mechanical and industrial	454	385	362	455	364	341	100	95	94
Electrical	408	357	352	386	336	319	95	94	91
Civil, agricultural, and architectural	397	336	313	335	290	268	84	86	86
50 percent:									
Mining and metallurgical	337	290	280	318	274	260	94	94	93
Chemical and ceramic	329	297	290	307	289	260	93	97	90
Mechanical and industrial	308	265	249	317	262	236	103	99	95
Civil, agricultural, and architectural	287	249	231	258	224	206	90	90	89
Electrical	276	252	246	272	238	229	99	94	93
75 percent:									
Mining and metallurgical	240	202	197	246	197	186	103	98	94
Chemical and ceramic	222	206	203	216	206	185	97	100	91
Mechanical and industrial	219	188	180	243	188	171	111	100	95
Civil, agricultural, and architectural	217	190	177	207	174	156	95	92	88
Electrical	199	187	187	206	179	168	104	96	90
90 percent:									
Mining and metallurgical	185	142	145	195	132	135	105	93	93
Civil, agricultural, and architectural	169	143	140	164	131	128	97	92	91
Mechanical and industrial	160	138	136	192	134	125	120	97	92
Chemical and ceramic	156	150	146	154	121	129	99	81	89
Electrical	145	145	144	159	128	126	110	89	88

[1] Includes those engineers who reported they were professionally active prior to 1930.
[2] Arranged in ascending order of graduate monthly engineering earnings for 1929.
[3] Graduate engineers include all postgraduates, nonengineering graduates, and first-degree engineering graduates.
[4] "Other" engineers include all engineers with college course incomplete, noncollegiate technical school course, and secondary-school education.

At the average and at the two lower levels of earnings, the ratios of engineering earnings of the two groups of engineers were practically the same as those noted for earned annual incomes. That is, in 1929 there was a slight advantage in favor of the "other" engineers, which was maintained to a somewhat greater degree in 1932 and 1934 than was the case for earned annual incomes. In part, however, this advantage in earnings of "other" engineers was due primarily to a higher age among the nongraduates in the groups compared.

Earnings Related to Age and Type of Education

The advantages in increased earning capacity accruing from formal education are better seen in table 71, which shows the engineering earnings by type of education and by age. Only the median earnings are given, as insufficient data were obtained to warrant a complete comparison for all age groups and types of education at the two higher and lower earnings levels.

TABLE 71.—*Median monthly engineering earnings in 1929, 1932, and 1934 of all engineers reporting, by age and type of education*

[Without regard to kind of engineering employment reported]

Age (in years)	Year of graduation	Years after graduation	Postgraduates	Nonengineering graduates	First-degree engineering graduates					Others with—				Secondary-school education
										College course incomplete		Noncollegiate technical course		
					Chemical and ceramic	Civil, agricultural, and architectural	Electrical	Mechanical and industrial	Mining and metallurgical	Civil, agricultural, and architectural	Mechanical and all others	Civil, agricultural, and architectural	Mechanical and all others	
			1929 earnings (in dollars)											
64 and over	(1)	41+	(2)	480	(2)	408	(2)	410	440	310	440	(2)	(2)	320
56–63	1889–96	33–40	484	493	510	424	484	506	493	315	420	347	380	360
48–55	1897–1904	25–32	455	482	493	407	438	483	437	318	423	286	402	353
40–47	1905–12	17–24	421	414	523	358	428	440	458	302	401	293	354	308
36–39	1913–16	13–16	350	416	487	328	368	405	405	273	335	269	326	310
32–35	1917–20	9–12	307	335	395	305	338	337	370	257	319	254	290	275
28–31	1921–24	5–8	266	255	295	260	264	285	284	220	267	218	253	233
26–27	1925–26	3–4	220	224	236	220	213	224	235	204	215	210	211	192
24–25	1927–28	1–2	180	166	179	187	167	180	183	184	193	187	186	183
23	1929	0	145	152	150	155	137	141	156	166	178	160	150	160
			1932 earnings (in dollars)											
67 and over	(1)	44+	(2)	260	(2)	336	(2)	420	(2)	247	380	(2)	(2)	295
59–66	1889–96	36–43	435	400	(2)	367	415	416	420	273	335	267	300	311
51–58	1897–1904	28–35	421	427	420	334	420	390	356	262	333	247	311	311
43–50	1905–12	20–27	365	384	443	307	353	351	374	258	326	249	289	273
39–42	1913–16	16–19	318	353	418	289	330	327	314	235	284	232	270	265
35–38	1917–20	12–15	294	305	324	262	309	301	300	226	263	222	244	234
31–34	1921–24	8–11	249	245	273	232	243	250	239	206	228	193	209	212
29–30	1925–26	6–7	220	227	223	208	202	211	206	187	189	180	180	173
27–28	1927–28	4–5	188	190	185	187	178	175	162	168	174	154	156	168
26	1929	3	157	149	149	164	152	152	149	149	148	163	150	130
25	1930	2	142	149	144	149	136	137	143	156	133	167	140	150
24	1931	1	119	120	124	134	118	120	114	145	131	(2)	135	140
23	1932	0	110	(2)	108	116	103	106	97	143	127	(2)	(2)	(2)
			1934 earnings (in dollars)											
69 and over	(1)	46+	(2)	250	(2)	306	(2)	330	(2)	210	310	(2)	(2)	280
61–68	1889–96	38–45	376	370	(2)	331	408	370	400	257	300	256	227	283
53–60	1897–1904	30–37	386	387	426	296	379	346	340	240	320	220	297	298
45–52	1905–12	22–29	339	353	425	285	349	333	347	236	301	227	261	252
41–44	1913–16	18–21	299	384	350	263	333	303	302	218	254	208	247	254
37–40	1917–20	14–17	279	305	340	244	300	283	311	201	247	199	228	229
33–36	1921–24	10–13	241	242	287	218	240	239	237	183	216	183	198	198
31–32	1925–26	8–9	217	208	228	198	205	207	207	166	184	158	180	162
29–30	1927–28	6–7	186	197	198	179	180	180	183	156	170	142	159	153
28	1929	5	166	164	170	163	162	165	153	145	153	160	150	134
27	1930	4	144	145	153	150	145	149	143	145	135	155	133	150
26	1931	3	137	131	134	143	127	132	143	137	145	110	131	153
25	1932	2	123	130	122	131	114	118	120	124	136	(2)	113	(2)
24	1933	1	120	123	114	126	109	110	118	126	117	(2)	138	(2)
23	1934	0	95	130	107	116	106	106	113	118	107	110	108	110

[1] Prior to 1889.

[2] Fewer than 10 engineers reported.

The extra years of experience which the "other" or nongraduate engineers had while the graduates were in school permitted of their obtaining higher earnings than graduates only up to a point corresponding to 5 years after graduation. Even at 2 years after graduation, in 1929 the differences in earnings between the two groups were slight. Thus, while the median monthly earnings of "other" or nongraduate engineers ranged from $183 for secondary-school engineers to $193 for mechanical engineers whose college course was incomplete, the earnings of graduates engaged in engineering work ranged from $166 per month for those with a nonengineering education to $187 for first-degree civil engineers. At 4 years after graduation, as will be seen from chart 13, the graduates were beginning to pull ahead of the "other" or nongraduate engineers. Thus, while the range in the median monthly earnings of the former was from $213 for first-degree electrical engineers to $236 a month for first-degree chemical and ceramic engineers, it was from $192 for engineers with secondary-school education to $215 a month for mechanical and industrial engineers with incomplete college courses in the case of the "other" or nongraduate engineers. Beginning at 5 years after graduation, the effect of a formal education on engineering earnings was accentuated. For example, at 11 years after graduation, the average monthly earnings of first-degree civil engineers were greater than those of the "other" or nongraduate engineers of this professional class. The median monthly earnings were $305 for graduates, $257 for those whose college courses were incomplete, and $254 for civil engineers who had attended noncollegiate technical schools. Similarly, in the case of first-degree electrical engineers and mechanical and industrial engineers, earnings were greater than those reported by the members of these professional classes whose college courses were incomplete or who had attended noncollegiate technical schools.[8]

It will also be noted that while mechanical engineers with incomplete college courses had the highest earnings of any of the groups of "other" or nongraduate engineers, their earnings differed very little from those of first-degree civil engineers. Thus, at 11 years after graduation the latter reported median earnings of $305 a month as against $319 a month for mechanical engineers with incomplete college courses. The corresponding figures at 29 years after graduation were $407 and $423 a month.

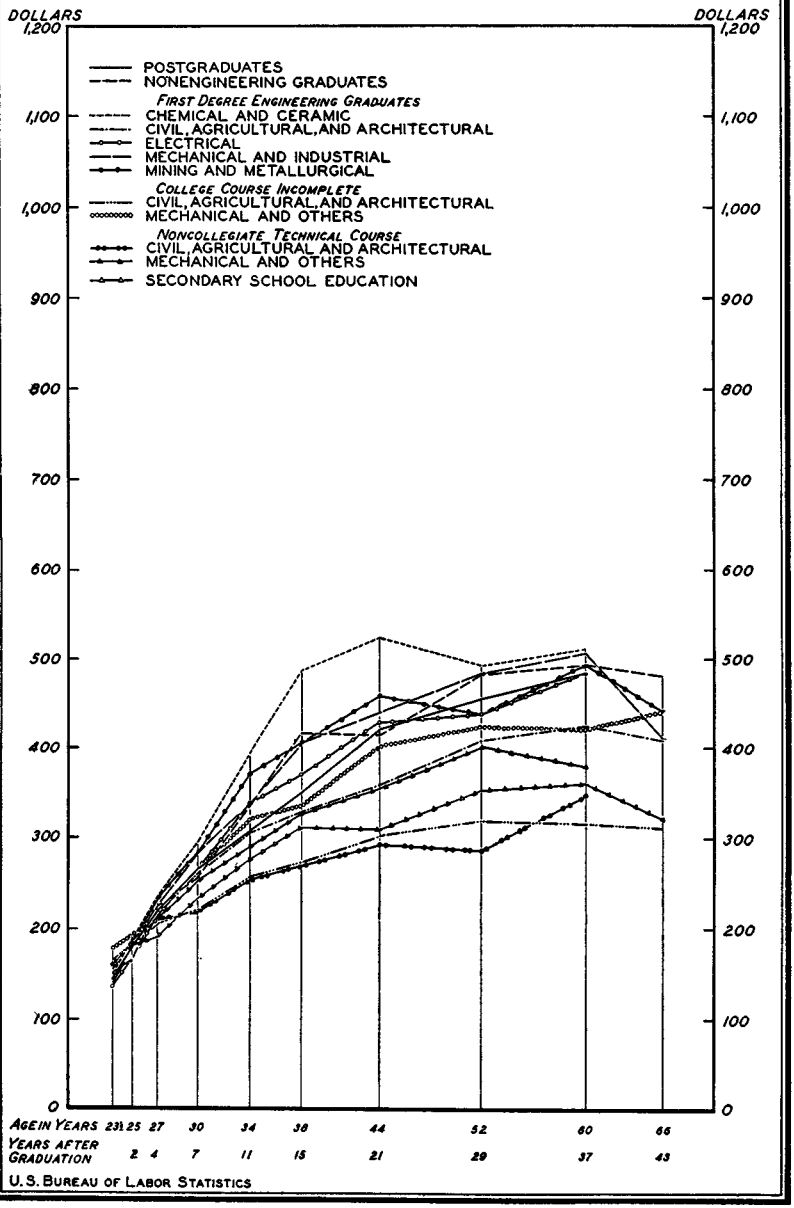
Furthermore, from 5 to 37 years after graduation, there was a fairly uniform relationship in the ranking of the earnings reported by the several types of education. Relatively, this uniformity was most marked among the "other" or nongraduate engineers. Thus,

[8] The term "mechanical and all others" shown in table 71 under "college course incomplete" and "noncollegiate technical schools" includes chemical and ceramic, electrical, industrial, and mining and metallurgical engineers.

CHART 13

COMPARISON OF MEDIANS OF MONTHLY RATE OF COMPENSATION ACCORDING TO AGE. 1929

INCLUDES COMPENSATION FOR ALL KINDS OF ENGINEERING SERVICES REPORTED



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while secondary-school engineers remained tenth in order, civil engineers whose college courses were incomplete, or who had attended noncollegiate technical schools, held, respectively, eleventh and twelfth places. Over the same period, first-degree chemical and ceramic engineers were first in order. They did, however, rank tenth at 2 years after graduation. Among the remaining types of education such shifts as did occur were not very pronounced. Even in 1934, the same relative positions were maintained.

With advancing age, the 1929 data show that there was a considerable advantage in engineering earnings in favor of the graduates. Thus, between civil engineers who had first degrees and those who had incomplete college courses, the differences for men 28, 33, 43, 53, and 60 years of age were $24, $45, $55, $93, and $109 a month, while between those with first degrees and noncollegiate technical school educations, the corresponding differences were $20, $48, $65, $118, and $77 a month.[9]

There was also a distinct variation in the earning capacities among both graduate and "other" or nongraduate engineers. Thus, at 10 years after graduation, the 1929 median monthly engineering earnings of graduates ranged from $290 for civil engineers to $368 for chemical and ceramic engineers. Graduates' median earnings 30 years after graduation ranged from $408 for civil engineers to $492 in the case of chemical and ceramic engineers. For "other" engineers, the range in earnings of men whose ages corresponded to 10 years after graduation, that is 33 years, was from $242 to $300 a month; and at 53 years of age, or corresponding to 30 years after graduation, the range was from $290 to $422 a month. At both of these age points, the lowest earnings among "other" engineers were reported by noncollegiate technical school civil engineers, the highest by mechanical and industrial engineers with incomplete college education.

A further advantage of formal engineering education was that graduate earnings from engineering work continued to increase for several years beyond the point of maximum earnings of "other" or nongraduate engineers. The earnings of the latter either remained stable or declined at 53 years of age.

Consideration will now be given to the effect of the depression on earnings of men with advancing years and experience and different educational backgrounds.

Over the period 1929–34, the data in table 72 indicate that the graduates who were 23½ years in 1929 and 28½ years in 1934 received increased earnings for all kinds of engineering, except in the case of mining and metallurgical. There were, however, no increases reported by any of the "other" or nongraduate engineers of corresponding

[9] Figures derived from data plotted on semilogarithmic-paper.

ages. By contrast, for the selected age groups of 52 to 57 and 44 to 49 years, decreases in earnings occurred among both graduate and "other" engineers in almost equal measure. For example, for engineers who were 44 years in 1929 and 49 in 1934, the earnings of the graduates declined from 19 to 24 percent, while those of the "other" engineers fell by 18 to 25 percent.

TABLE 72.—*Comparison of median monthly engineering earnings in 1929, 1932, and 1934 of selected age groups of engineers reporting, by type of education*

[Without regard to kind of engineering employment reported]

Type of education	Engineers whose ages were—														
	60 in 1929	63 in 1932	65 in 1934	52 in 1929	55 in 1932	57 in 1934	44 in 1929	47 in 1932	49 in 1934	25 in 1929	28 in 1932	30 in 1934	23½ in 1929	26½ in 1932	28½ in 1934
	Median monthly engineering earnings														
Postgraduates	$484	$435	$376	$455	$421	$386	$421	$365	$339	$180	$188	$186	$145	$157	$166
Nonengineering graduates	493	400	370	482	427	387	414	384	353	166	190	197	152	149	164
First-degree engineering graduates:															
Chemical and ceramic	510	(1)	(1)	493	420	426	523	443	425	179	185	198	150	149	170
Civil, agricultural, and architectural	424	367	331	407	334	296	358	307	285	187	187	179	155	164	163
Electrical	484	415	408	438	400	379	428	353	349	167	178	180	137	152	162
Mechanical and industrial	506	416	370	483	390	346	440	351	333	180	175	180	141	152	165
Mining and metallurgical	493	420	400	437	356	340	458	374	347	183	162	183	156	149	153
College course incomplete:															
Civil, agricultural, and architectural	315	273	257	318	262	240	302	258	236	184	168	156	166	149	145
Mechanical and others [2]	420	335	300	423	333	320	401	326	301	193	174	170	178	148	153
Noncollegiate technical course:															
Civil, agricultural, and architectural	347	267	256	286	247	220	293	249	227	187	154	142	160	163	160
Mechanical and others [2]	380	300	227	402	311	297	354	289	261	186	156	159	150	150	150
Secondary-school education	360	311	283	353	311	298	308	273	252	183	168	153	160	130	134
	Percentage increase or decrease—														
	1929 to 1934	1929 to 1932	1932 to 1934	1929 to 1934	1929 to 1932	1932 to 1934	1929 to 1934	1929 to 1932	1932 to 1934	1929 to 1934	1929 to 1932	1932 to 1934	1929 to 1934	1929 to 1932	1932 to 1934
Postgraduates	−22	−10	−14	−15	−7	−8	−19	−13	−7	+3	+4	−1	+14	+8	+6
Nonengineering graduates	−25	−19	−8	−20	−11	−9	−15	−7	−8	+19	+14	+4	+8	−2	+10
First-degree engineering graduates:															
Chemical and ceramic	(1)	(1)	(1)	−14	−15	+1	−19	−15	−4	+11	+3	+7	+13	−1	+14
Civil, agricultural, and architectural	−22	−13	−10	−27	−18	−11	−20	−14	−7	−4	0	−4	+5	+6	−1
Electrical	−16	−14	−2	−13	−4	−10	−18	−18	−1	+8	+7	+1	+18	+11	+7
Mechanical and industrial	−27	−18	−11	−28	−19	−11	−24	−20	−5	0	−3	+3	+17	+8	+9
Mining and metallurgical	−19	−15	−5	−22	−19	−4	−24	−18	−7	0	−11	+13	−2	−4	+3
College course incomplete:															
Civil, agricultural, and architectural	−18	−13	−6	−25	−18	−8	−22	−15	−9	−15	−9	−7	−13	−10	−3
Mechanical and others [2]	−29	−20	−10	−24	−21	−4	−25	−19	−8	−12	−10	−2	−14	−17	+3
Noncollegiate technical course:															
Civil, agricultural, and architectural	−26	−23	−4	−23	−14	−11	−23	−15	−9	−24	−18	−8	0	+2	−2
Mechanical and others [2]	−40	−21	−24	−26	−23	−5	−26	−18	−10	−15	−16	+2	0	0	0
Secondary-school education	−21	−14	−9	−16	−12	−4	−18	−11	−8	−16	−8	−9	−16	−19	+3

[1] Fewer than 10 engineers reported.
[2] Includes chemical and ceramic, electrical, industrial, and mining and metallurgical engineers.

On the other hand, for men with identical years of experience, the earnings received in 1934 by both graduates and "other" engineers

were all less than those which were obtained in 1929. Thus, in table 73 it will be noted that at 2 years after graduation the earnings obtained for engineering services in 1934 were less than those received in 1929 by from 32 to 41 percent for all types of education, except nonengineering graduates and those engineers with a secondary-school education. In the case of nonengineering graduates, the earnings were 24 percent less and for engineers with secondary-school education they were 29 percent less.

Again it will be noted that the decreases reported by men with 5 years' experience were, in general, greater than those for men who had had but 2 years' experience and also greater than the declines in earnings reported for men with from 10 to 37 years' experience.

TABLE 73.—*Percentage decrease in median monthly engineering earnings, 1929 to 1934, for corresponding years after graduation, by type of education*

[Without regard to kind of engineering employment reported]

Type of education	Percentage decrease in earnings at specified years after graduation					
	2	5	10	20	30	37
Postgraduates	32	34	24	26	21	21
Nonengineering graduates	24	33	30	[1] 8	23	23
First-degree engineering graduates:						
Chemical and ceramic	34	36	33	31	14	(2)
Civil, agricultural, and architectural	32	32	30	25	29	27
Electrical	34	33	31	20	18	19
Mechanical and industrial	39	35	32	[1] 10	30	30
Mining and metallurgical	37	42	37	32	22	27
College course incomplete:						
Civil, agricultural, and architectural	33	30	31	26	24	21
Mechanical and others [3]	34	37	36	34	27	25
Noncollegiate technical course:						
Civil, agricultural, and architectural	41	26	31	27	23	33
Mechanical and others [3]	36	37	34	29	31	24
Secondary-school education	29	28	34	18	23	19

[1] Despite the fact that at 20 years after graduation, nonengineering graduates and mechanical and industrial engineers show only 8- and 10-percent decreases in earnings, the consistency of the remaining decreases shown is too regular for these particular differences to have any effect on the general argument.
[2] Fewer than 10 engineers reported.
[3] Includes chemical and ceramic, electrical, industrial, and mining and metallurgical engineers.

Earnings by Kind of Engineering Employment

In the preceding section no attempt was made to relate earnings to the kinds of engineering employment reported at the end of 1929, 1932, and 1934.[10] The numbers of engineers [11] who furnished this particular information are shown compared in table 74 with the numbers who also stated their monthly rate of compensation. In each of the 3 years

[10] Employment (1) with private firm, (2) as independent consultant, (3) in teaching, or with (4) Federal, (5) State and county, or (6) municipal and other public authorities.

[11] The general analysis of engineering earnings in 1929 was based on 28,511 engineers; table 74 shows only 27,206 engineers reporting kind of employment and earnings in the same yeer. The difference of 1,305 is accounted for as follows: The data for 28,511 engineers were complied from two separate tabulations—one for graduates by year of graduation, and a second for "other" engineers by year of birth. The data for the 27,206 engineers were compiled by year of birth only. Clearly, 1,305 graduates did not furnish their year of birth.

more than 90 percent reported monthly engineering earnings. This was the case for all types of engineering employment, except independent consulting. Among consultants the proportions reporting earnings ranged from 69.5 percent in 1932 to 76.0 percent in 1929.

TABLE 74.—*Comparison of total number of engineers reporting kind of engineering employment only and total number reporting monthly earnings from engineering employment at end of 1929, 1932, and 1934*

[Figures adjusted as explained on p. 34]

Kind of engineering employment	All engineers								
	1929			1932			1934		
	Total number reporting	Number reporting income	Percentage reporting income	Total number reporting	Number reporting income	Percentage reporting income	Total number reporting	Number reporting income	Percentage reporting income
All kinds	29,298	27,206	92.9	28,373	25,990	91.6	31,870	29,820	93.6
Private firm	19,590	18,162	92.7	16,728	15,211	90.9	18,433	17,110	92.8
Chemical and ceramic	1,035	949	91.7	1,143	1,044	91.3	1,597	1,496	93.7
Civil, agricultural, and architectural	5,193	4,863	93.6	3,608	3,231	89.6	3,258	3,003	92.2
Electrical	5,844	5,461	93.4	5,300	4,900	92.5	5,651	5,287	93.6
Mechanical and industrial	6,588	6,041	91.7	5,849	5,289	90.4	6,951	6,421	92.4
Mining and metallurgical	930	848	91.2	828	747	90.2	976	903	92.5
Independent consulting	1,311	997	76.0	1,500	1,042	69.5	1,295	949	73.3
Teaching	1,716	1,626	94.8	1,934	1,828	94.5	1,895	1,820	96.0
Federal Government	1,614	1,510	93.6	2,340	2,227	95.2	4,137	3,974	96.1
State and county government	2,677	2,617	97.8	3,422	3,338	97.5	3,694	3,634	98.4
Municipal government and other public authority	2,390	2,294	96.0	2,449	2,344	95.7	2,416	2,333	96.6

Since the earnings by kind of engineering employment are first discussed without regard to age, it is pertinent at the outset to note that there is a distinct variation in the age composition of the samples of reporting engineers in the several professional classes. This is made evident by considering the numbers of those engineers, classified by age, who reported that they were in the employ of private firms in 1934 (table 75). The differences in age composition seriously affect comparisons between chemical engineers and the other four professional classes. Among the men engaged in chemical engineering in 1934 some 36.5 percent constituted men who had entered the profession since 1929. By contrast, the proportions of the younger engineers in the other professions were less striking, ranging from 14.3 percent in the case of electrical engineers to 18.1 percent for mechanical and industrial engineers.

TABLE 75.—*Age distribution in 1934 of engineers employed by private firms reporting monthly compensation solely from engineering work, by professional class*

[Figures adjusted as explained on p. 34]

Professional class	Total	Age in years											
		Younger engineers [1]					Older engineers [2]						
		20–23	24	25	26	27	28	29	30–39	40–49	50–59	60–69	70 and over
	Number												
Chemical and ceramic	1,496	180	106	102	95	63	86	84	414	261	85	19	1
Civil, agricultural, and architectural	3,003	126	70	80	83	92	96	91	834	896	484	128	23
Electrical	5,287	175	117	146	175	145	335	306	2,063	1,215	517	86	7
Mechanical and industrial	6,421	320	214	207	231	195	318	253	2,231	1,545	713	180	14
Mining and metallurgical	903	40	27	27	27	26	44	33	280	257	115	25	2
	Percentage												
Chemical and ceramic	100.0	12.0	7.1	6.8	6.4	4.2	5.7	5.6	27.7	17.5	5.7	1.2	0.1
Civil, agricultural, and architectural	100.0	4.2	2.3	2.7	2.8	3.1	3.2	3.0	27.7	29.8	16.1	4.3	0.8
Electrical	100.0	3.3	2.2	2.8	3.3	2.7	6.3	5.8	39.1	23.0	9.8	1.6	0.1
Mechanical and industrial	100.0	5.0	3.3	3.2	3.6	3.0	5.0	3.9	34.8	24.1	11.1	2.8	0.2
Mining and metallurgical	100.0	4.4	3.0	3.0	3.0	2.9	4.9	3.7	31.0	28.4	12.7	2.8	0.2

[1] Graduate and "other" engineers who entered the profession in the years 1930–34, inclusive.
[2] Graduate and "other" engineers who reported they were professionally active prior to 1930.

Furthermore, in the case of those engineers who reported that they were professionally active prior to 1930, it will also be noted that chemical and ceramic engineering comprised a relatively higher proportion of younger men, as was also the case for electrical engineering. On the other hand, the proportion of older men in the three other professional classes was greater. These proportions were approximately the same for mechanical and industrial engineers and mining and metallurgical engineers, and relatively higher in the case of civil engineers.[12]

In table 76 the effort is made to contrast the earnings opportunities afforded by different kinds of employment, which is of significance insofar as one kind of employment uses a larger proportion of younger engineers than another. Even though one pays as much as or more than another for engineers with any given amount of experience, it may be incorrect to assume that it offers as much high-salaried employment as that form of employment that uses a larger proportion of experienced engineers. In this sense, it is correct to say that in 1929 private-firm employment in mining and metallurgical engineering paid the highest rates for its engineering services as a

[12] These differences in age composition should be borne in mind throughout the ensuing analysis. Similar remarks apply to the later discussion of earnings by (1) fields of engineering activity, (2) types of engineering work, (3) regional location, and (4) size of city. Furthermore, since the incidence and intensity of the depression on corresponding age groups in each professional class has been shown to be fairly consistent, an analysis of the age composition of each one for 1929 or 1932 would not differ markedly from that shown for 1934.

whole, that private employment in chemical engineering came next, and was followed in order by mechanical, civil, and electrical engineering. In the order as stated, the median monthly earnings reported for 1929 were $338, $341, $314, $300, and $276. These relationships held at all levels of earnings with only one significant exception.

TABLE 76.—*Comparison of 5 levels of monthly engineering earnings at end of 1929, 1932, and 1934 of all engineers reporting, by kind of engineering employment*

[Figures adjusted as explained on p. 3]

Kind of engineering employment	Proportion with monthly engineering income of more than specified amount														
	10 percent			25 percent			50 percent			75 percent			90 percent		
	1929	1932	1934	1929	1932	1934	1929	1932	1934	1929	1932	1934	1929	1932	1934
	Dol	*Dol*	*Dol*	*Dol*	*Dol*	*Dol*	*Dol*	*Dol*	*Dol*	*Dol*	*Dol*	*Dol*	*Dol*	*Dol*	*Dol*
Private firm	638	522	491	434	358	329	301	247	220	220	170	150	167	127	112
Chemical and ceramic	746	606	518	498	414	342	341	258	197	230	159	131	174	125	103
Civil, agricultural, and architectural	618	508	475	422	345	322	300	247	229	226	179	162	180	126	122
Electrical	581	506	479	404	342	324	276	235	220	204	167	154	153	128	115
Mechanical and industrial	684	538	490	465	373	328	314	253	216	228	171	145	173	126	108
Mining and metallurgical	797	612	571	510	416	377	338	277	240	244	176	154	189	126	119
Independent consulting	1,251	727	763	731	430	426	439	245	256	291	144	153	209	86	94
Teaching	554	507	478	417	375	357	310	281	266	240	215	204	190	164	153
Federal Government	434	408	373	351	318	275	264	230	204	196	173	154	163	143	129
State and county government	377	345	320	303	272	242	236	212	190	195	159	148	155	132	122
Municipal government and other public authority	457	425	399	347	324	302	272	248	227	222	200	176	188	152	140
	Percentage increase or decrease														
	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34
Private firm	−23	−18	−6	−24	−18	−8	−27	−18	−11	−32	−23	−12	−33	−24	−12
Chemical and ceramic	−31	−19	−15	−31	−17	−17	−42	−24	−24	−43	−31	−18	−41	−28	−18
Civil, agricultural, and architectural	−23	−18	−6	−24	−18	−7	−24	−18	−7	−28	−21	−9	−32	−30	−3
Electrical	−18	−13	−5	−20	−15	−5	−20	−15	−6	−25	−18	−8	−25	−16	−10
Mechanical and industrial	−28	−21	−9	−29	−20	−12	−31	−19	−15	−36	−25	−15	−38	−27	−14
Mining and metallurgical	−28	−23	−7	−26	−18	−9	−29	−18	−13	−37	−28	−13	−37	−33	−6
Independent consulting	−39	−42	+5	−42	−41	−1	−42	−44	+4	−47	−51	+6	−55	−59	+9
Teaching	−14	−8	−6	−14	−10	−5	−14	−9	−5	−15	−10	−5	−19	−14	−7
Federal Government	−14	−6	−9	−22	−9	−14	−23	−13	−11	−21	−12	−11	−21	−12	−10
State and county government	−15	−8	−7	−20	−10	−11	−19	−10	−10	−24	−18	−7	−21	−15	−8
Municipal government and other public authority	−13	−7	−6	−13	−7	−7	−17	−9	−8	−21	−10	−12	−26	−19	−8

However, these figures do not shed light directly on the adequacy of the rates paid for similar types of service. For example, electrical engineers in 1934 were younger than civil engineers (table 75). It is perhaps not surprising, therefore, that in 1929 electrical engineers earned less than civil engineers in private-firm employment. Nor is it surprising that at the level of earnings of the lowest 10 percent in private employ in 1929, civil engineers should rise from fourth to second place. Conversely, the earnings of chemical engineers in private firm employment in 1929 appear in even a more favorable light when it is realized that they are nearly the same as for the older group of mining engineers at the three intermediate levels.

From 1929 to 1934 there were great changes in rates of pay at all earnings levels among engineers in the employ of private firms. Differences among the various professional classes resulted in some inversion of the relative level of earnings from that reported in 1929. The order of the professional groups was the same in 1929 and 1934 for the upper 10 and 25 percent in private-firm employment, except that civil engineers were below electrical engineers in 1934. However, civil engineers rose from fifth to second place at the median and lower levels and chemical engineers fell from second to fifth. Here again, these were the rates paid in various types of engineering service. But in 1934, while 78.7 percent of the civil engineers in private-firm employment were 30 years or older, the proportion of chemical and ceramic engineers in this same age group was only 52.2 percent.

In both 1929 and 1934 there was a marked spread in the earnings in private-firm employment of each professional group. As between the groups, however, there were significant differences. In 1929, the earnings of the upper 10 percent of reporting civil engineers were 106 percent greater than the median earnings of the group, the corresponding difference for mining and metallurgical engineers was 135 percent. In the case of the other three professional classes, the differences were: 111 percent for electrical engineers, 117 percent for mechanical and industrial engineers, and 119 percent for chemical and ceramic engineers. These differences in spread as between the professional groups were even more marked in 1934. Thus, the earnings of the upper 10 percent of reporting civil engineers were 107 percent greater than the median earnings of the group, the corresponding difference for mining and metallurgical engineers was 138 percent. The differences for the other three professional classes were: 118 percent for electrical engineers, and 127 and 163 percent, respectively, for mechanical and industrial, and chemical and ceramic engineers.

As is evident from these figures, in all professional groups there was a somewhat greater dispersion of rates of pay in private-firm employment in 1934 than in 1929. That is to say, that in each professional class, rates of pay of engineers in the employ of private firms declined slightly more at the level of the lowest 10 percent than at the level of the highest 10 percent, and at the level of the lowest 25 percent than at the level of the highest 25 percent. Thus, the upper 10 percent of the chemical engineers in private employ earned at least 5 times as much as the lower 10 percent in 1934; in 1929 they had earned 4.3 times as much. The smallest increase in spread occurred at these levels among electrical engineers, the ratios being 3.8 in 1929 and 4.2 in 1934.

While there was a general tendency to increased dispersion of rates of pay in private-firm employment between 1929 and 1934, it was

more marked as regards the upper and lower 25 percent than with regard to the upper and lower 10 percent. Thus, among chemical engineers the upper 25 percent earned 2.2 times as much as the lower 25 percent in 1929; 2.6 times as much in 1934. This measure of dispersion at this level increased 20 percent; at the 10-percent level, cited in the earlier paragraph, 17 percent.

In contrasting the rates of pay for all engineers in other kinds of employment it has not been possible to distinguish the professional groups. Nor are there enough cases to warrant the presentation of the age distributions such as were shown for private-firm employment. Age is an important factor, especially in evaluating the significance of the higher earnings in independent consulting.

In 1929 there was a considerable range in earnings opportunities among the various kinds of engineering employments. While one-half of the engineers in the employ of State and county governments earned not less than $236 a month—the lowest at this earnings level—the highest median monthly earnings of $439 were reported by independent consultants. Second in order at this same earnings level came the earnings of engineers who reported that they were engaged in the teaching of engineering subjects with $310 per month, followed by median monthly earnings of $301 for all reporting engineers in the employ of private firms. Third and fourth in order were, respectively, the earnings of engineers in the employ of municipal governments and other public authorities, and the Federal Government, the respective figures being $272 and $264 a month.

The gradation of earnings at the two lower earnings levels was the same as that noted for the median. At the two higher earnings levels private-firm employment exceeded teaching, being second in order after independent consultants, while the earnings of all three public engineering employments were lower in each instance than those of engineers engaged in teaching.

In other words, while a smaller proportion of the engineers engaged in teaching were employed at low salaries than among those employed by private firms, a smaller proportion of the teachers were employed at high salaries. Thus, in 1929 the upper 10 percent of the teachers earned $554 per month, the lower 10 percent earned $190. In private-firm employment the spread was from $638 to $167, and in municipal employment the spread was even narrower—from $457 to $188 per month. Here, as in teaching, a smaller proportion were employed at low salaries than in private employment, but the largest difference was in the proportion at high salaries. In 1929 the Federal Government paid the lower 10 percent of its engineers as little as private industry, but the upper 10 percent earned only $434 per month or more. State and county work offered the smallest proportion of jobs at the higher salaries. In fact, the level of earnings of the upper

25 percent in 1929 was about the same as the average in private employment.

Although these data show that independent consultants had a distinct advantage in earnings, it cannot be said that this field of employment offered the greatest opportunities. In the first instance, independent consulting is generally agreed to be one in which professional engineers become established only after having obtained considerable engineering experience. Furthermore, it is questionable if such a thing as a rate of compensation can be applied to this field of engineering service, for, unlike the other kinds of engineering employment, the rates reported were almost necessarily derived directly from the earned annual incomes reported. These undoubtedly are made up from fees dependent on experience and skill, as well as the cost of completion of work, rather than from a salary scale.

Over the period 1929–34 there was an especially marked decline in the earnings of independent consultants as compared with the decline in rates for the other kinds of employment. These changes are to be regarded as in large part a measure of under-employment.

In the other kinds of employment, the largest decline (27 percent) in average rates paid was in private-firm employment. The smallest decline (14 percent) was in teaching. State and county, and municipal and other public employment declined 19 percent and 17 percent, respectively. Average rates with the Federal Government, reflecting in part the influx of many younger engineers, declined 23 percent.

The relative attractiveness of the several employments, even aside from differences in stability of employment, changed markedly. Thus, in 1929 teaching averaged $310 and private-firm employment $301 per month. In 1934, teaching averaged $266; private-firm employment $220. In 1929 municipal employment averaged $29 less than private; in 1934, $7 more. The changes at the extremes were even more marked. The upper 10 percent of the teachers averaged $84 less than the corresponding group of private-firm employees in 1929; but only $13 less in 1934.

In private-firm employment, in teaching, and among engineers employed by municipal and other public authorities, earnings of the upper 10 and 25 percent declined less than the average; earnings of the lower 10 and 25 percent, somewhat more than the average. In Federal Government employment, the declines at all but the highest level of earnings were similar to the decline of the average rate. Thus, in general, the spread of earnings was greater in 1934 than in 1929, especially the spread between the level of earnings of the upper 10 percent and the lower 10 percent. At these levels the greatest increase in the range occurred in municipal employment (17 percent) and private employment (15 percent). Thus, the upper 10 percent

of the municipal engineers in 1934 earned at least 2.9 times as much as the lower 10 percent; in 1929, 2.4 times as much. As between the upper and lower 25 percent, there was no change in the relative spread of earnings from 1929 to 1934 for teachers and Federal employees. There was about a 10-percent greater spread for private-firm employees and municipal engineers.

Valuable as the findings of the preceding analyses are it has been indicated that they must be accepted qualifiedly because it was not feasible for the Bureau to effect tabulations of these data on an age basis. Accordingly, partially to clarify such differing relationships as may exist between age and the earnings received from the several kinds of engineering employment, a separate analysis of these earnings as reported by both older and younger engineers is warranted.

Again in table 77 it will be noted that the proportions reporting earnings were in general not lower than 90 percent of the total of those reporting in each kind of engineering employment, while the proportion of independent consultants reporting was relatively much lower.

The earnings data for the older engineers, that is, those men who reported they were professionally active prior to 1930, will first be considered. These are shown in table 78. However, since the earnings reported for 1929 are the same as those discussed in the preceding analysis, consideration will be given only to the changes which occurred in them over the period 1929–34.

These figures emphasize the extent to which earnings in 1934 were diluted by the influx of younger engineers. It has previously been indicated that, considering each group of employed engineers as a whole, earnings fell more at the lower levels than at the higher. This did not occur among the homogeneous age groups. For the "older" engineers the four other earnings levels sank in almost exactly the same ratio as the average in the case of private-firm employment, teaching, Federal Government, and State government employment.

Furthermore, the average decline for this age group was materially less than was the case for the employment as a whole. In the case of teaching, the decline in earnings was 12 percent, the three kinds of public engineering employment averaged decreases of 14 percent, while earnings of men in private engineering fell by only 18 percent.

TABLE 77.—*Comparison of total number of engineers reporting kind of engineering employment only and total number reporting monthly earnings from engineering employment at end of 1929, 1932, and 1934, by age group*

Kind of engineering employment	Engineers born prior to 1907 [1]									Engineers born 1907–9 [2]						Engineers born 1910–14 [3]		
	1929			1932			1934			1932			1934			1934		
	Total number reporting	Number reporting income	Percentage reporting income	Total number reporting	Number reporting income	Percentage reporting income	Total number reporting	Number reporting income	Percentage reporting income	Total number reporting	Number reporting income	Percentage reporting income	Total number reporting	Number reporting income	Percentage reporting income	Total number reporting	Number reporting income	Percentage reporting income
All kinds	29,298	27,206	92.9	26,402	24,178	91.6	27,097	25,258	93.2	4,205	3,869	92.0	5,836	5,634	96.5	4,347	4,115	94.7
Private firm	19,590	18,162	92.7	15,487	14,081	90.9	15,210	14,041	92.3	2,646	2,413	91.2	3,765	3,616	96.0	3,114	2,936	94.3
Chemical and ceramic	1,035	949	91.7	976	891	91.3	1,030	950	92.2	356	326	91.6	575	555	96.5	634	610	96.2
Civil, agricultural, and architectural	5,193	4,863	93.6	3,357	3,010	89.7	2,778	2,552	91.9	535	471	88.0	577	545	94.5	448	419	93.5
Electrical	5,844	5,461	93.4	4,939	4,567	92.5	4,847	4,529	93.4	770	710	92.2	1,042	993	95.3	675	624	92.4
Mechancial and industrial	6,588	6,041	91.7	5,429	4,904	90.3	5,734	5,254	91.6	895	824	92.1	1,389	1,350	97.2	1,207	1,139	94.4
Mining and metallurgical	930	848	91.2	786	709	90.2	821	756	92.1	90	82	91.1	182	173	95.1	150	144	96.0
Independent consulting	1,311	997	76.0	1,479	1,028	69.5	1,275	935	73.3	44	31	70.5	25	22	88.0	18	14	77.8
Teaching	1,716	1,626	94.8	1,844	1,751	95.0	1,782	1,720	96.5	193	165	85.5	149	139	93.3	91	75	82.4
Federal Government	1,614	1,510	93.6	2,141	2,033	95.0	3,436	3,292	95.8	425	413	97.2	940	920	97.9	555	535	96.4
State and county government	2,677	2,617	97.8	3,098	3,029	97.8	3,147	3,100	98.5	692	660	95.4	735	721	98.1	430	419	97.4
Municipal government and other public authority	2,390	2,294	96.0	2,353	2,256	95.9	2,247	2,170	96.6	205	187	91.2	222	216	97.3	139	136	97.8

[1] Includes both graduate and "other" engineers who reported they were professionally active prior to 1930; all tabulated on year-of-birth basis.
[2] Includes both graduate and "other" engineers who entered the profession during the years 1930–32.
[3] Includes both graduate and "other" engineers who entered the profession during the years 1933–34.

TABLE 78.—*Comparison of 5 levels of monthly engineering earnings at end of 1929, 1932, and 1934 of all older* [1] *engineers reporting, by kind of engineering employment*

Kind of engineering employment	Proportion with monthly engineering income of more than specified amount														
	10 percent			25 percent			50 percent			75 percent			90 percent		
	1929	1932	1934	1929	1932	1934	1929	1932	1934	1929	1932	1934	1929	1932	1934
All engineers born prior to 1907	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
Private firm	638	544	517	434	377	360	301	260	248	220	186	183	167	138	139
Chemical and ceramic	746	640	652	498	435	430	341	296	289	230	198	197	174	142	145
Civil, agricultural, and architectural	618	517	501	422	356	350	300	257	249	226	192	192	180	137	146
Electrical	581	516	503	404	353	346	276	246	239	204	181	181	153	138	137
Mechanical and industrial	684	563	515	465	395	360	314	268	244	228	187	176	173	139	133
Mining and metallurgical	797	621	623	510	425	419	338	287	275	244	190	190	189	136	144
Independent consulting	1,251	732	767	731	432	428	439	248	259	291	146	156	209	87	96
Teaching	554	511	485	417	383	364	310	288	273	240	222	212	190	177	168
Federal Government	434	416	391	351	328	297	264	242	225	196	182	169	163	150	142
State and county government	377	351	332	303	280	257	236	220	203	195	174	160	155	142	137
Municipal government and other public authority	457	429	407	347	328	309	272	252	234	222	203	186	188	159	148
	Percentage increase or decrease														
	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34	1929–34	1929–32	1932–34
All engineers born prior to 1907															
Private firm	−19	−15	−5	−17	−13	−5	−18	−14	−5	−17	−15	−2	−17	−17	+1
Chemical and ceramic	−13	−14	+2	−14	−13	−1	−15	−13	−2	−14	−14	−1	−17	−18	+2
Civil, agricultural, and architectural	−19	−16	−3	−17	−16	−2	−17	−14	−3	−15	−15	0	−19	−24	+7
Electrical	−13	−11	−3	−14	−13	−2	−13	−11	−3	−11	−11	0	−10	−10	−1
Mechanical and industrial	−25	−18	−9	−23	−15	−9	−22	−15	−9	−23	−18	−6	−23	−20	−4
Mining and metallurgical	−22	−22	0	−18	−17	−1	−19	−15	−4	−22	−22	0	−24	−28	+6
Independent consulting	−39	−41	+5	−41	−41	−1	−41	−44	+4	−46	−50	+7	−54	−58	+10
Teaching	−12	−8	−5	−13	−8	−5	−12	−7	−5	−12	−8	−5	−12	−7	−5
Federal Government	−10	−4	−6	−15	−7	−9	−15	−8	−7	−14	−7	−7	−13	−8	−5
State and county government	−12	−7	−5	−15	−8	−8	−14	−7	−8	−18	−11	−8	−12	−8	−4
Municipal government and other public authority	−11	−6	−5	−11	−5	−6	−14	−7	−7	−16	−9	−8	−21	−15	−7

[1] Includes both graduate and "other" engineers who reported they were professionally active prior to 1930; all tabulated on year-of-birth basis.

Those engineers who entered the profession in the years 1930–32 (table 79) reported slight increases in the earnings received in 1934 over those obtained in 1932. But engineers who entered the profession in the years 1933–34 received less in 1934 than did those in 1932 who had entered the profession in 1930–32. For example, while the median monthly earnings in 1932 of engineers born in 1907–9 were $133 with private firms, the most recent entrants to the profession received only $112 a month in 1934. The corresponding figures for Federal employment were $155 and $133 a month.[13]

[13] It should, however, be noted that the earnings data for engineers who entered the profession in the years 1930–32 covered a period of 3 years, as against 2 years in the case of the later entrants to the profession.

TABLE 79.—*Comparison of 5 levels of monthly engineering earnings at end of 1932 and 1934 of all younger [1] engineers reporting, by kind of engineering employment*

Kind of engineering employment [2]	Engineers born 1907–9										Engineers born 1910–14				
	1932 income (dols.)					1934 income (dols.)					1934 income (dols.)				
	90 percent earned more than	75 percent earned more than	50 percent earned more than	25 percent earned more than	10 percent earned more than	90 percent earned more than	75 percent earned more than	50 percent earned more than	25 percent earned more than	10 percent earned more than	90 percent earned more than	75 percent earned more than	50 percent earned more than	25 percent earned more than	10 percent earned more than
Private firm	90	111	133	155	186	92	111	136	162	195	81	94	112	132	152
Chemical and ceramic	99	116	139	158	188	96	117	140	169	205	82	96	114	134	153
Civil, agricultural, and architectural	90	112	136	158	196	101	117	140	167	207	84	101	120	139	157
Electrical	90	111	134	155	179	90	110	136	162	193	78	92	110	128	148
Mechanical and industrial	89	108	129	152	183	88	108	132	159	192	80	91	109	129	148
Mining and metallurgical	(3)	101	125	148	(3)	94	114	136	158	185	82	93	112	133	152
Teaching	87	111	137	173	205	97	126	152	184	220	(3)	63	108	142	(3)
Federal Government	106	132	155	172	189	113	131	149	167	189	100	114	133	153	172
State and county government	95	116	141	155	171	102	118	139	155	174	85	101	117	134	151
Municipal government and other public authority	92	115	155	202	228	104	121	142	162	190	87	103	123	150	186

[1] Includes both graduate and "other" engineers who entered the profession in the years 1930–32 and 1933–34; all tabulated on a year-of-birth basis.
[2] The earnings reported for independent consulting by the younger engineers are not believed to be significant, and therefore are omitted.
[3] Fewer than 100 persons reported.

While the 2 preceding analyses have dealt with monthly engineering earnings in 6 kinds of engineering employment, similar data were also requested in regard to two other aspects of engineering services: (1) The field of engineering activity,[14] and (2) the type of work[15] engaged in within these fields of activity. It should again be emphasized that these data were given only for the period ending December 31, 1934, and as in the immediately preceding discussion these two groups of data are analyzed separately for older and younger engineers.

Earnings by Field of Engineering Activity [16]

In table 80 there are presented the numbers of engineers who reported the field of engineering activity in which they were engaged at the end of 1934. Of all older engineers reporting, 93 percent furnished their monthly rates of compensation, while, for the two groups of younger engineers the proportions furnishing this information were 95 and 96 percent. This was also the case for the several fields of activity. The earnings data for these older engineers are presented in table 81.

[14] These comprise: (1) Construction, (2) extractive industries, (3) public utilities, (4) transportation, (5) manufacturing, (6) personal service, and (7) Federal, (8) State and county, and (9) municipal governments.

[15] These comprise: (1) Design and research, (2) construction, (3) operation, (4) consulting, (5) teaching, (6) sales, and (7) general administration and management.

[16] A hand tabulation was made to determine the age composition of the engineers in the 5 professional classes who reported they were engaged by public utilities and in personal service. This showed that, relatively, the age composition of each professional class was similar to that noted for private firm employment as shown in table 75.

TABLE 80.—*Number of engineers reporting monthly engineering earnings at end of 1934, by field of engineering activity*

Age group	Total	Field of engineering activity								
		Private employment						Public employment [1]		
		Construction	Extractive industries	Public utilities	Transportation	Manufacturing	Personal service	Federal Government	State and county government	Municipal government
	Number									
Older engineers: [2]										
Gross number reporting	25,967	2,696	1,267	3,148	1,006	7,083	2,387	3,260	3,266	1,854
Number reporting earnings	24,223	2,374	1,162	2,959	946	6,484	2,210	3,106	3,196	1,786
Engineers born 1907–9: [3]										
Gross number reporting	5,731	426	320	687	134	2,107	253	884	767	153
Number reporting earnings	5,524	406	305	671	133	2,023	238	855	745	148
Engineers born 1910–14: [3]										
Gross number reporting	4,192	356	273	384	124	1,802	168	548	443	94
Number reporting earnings	3,972	333	260	360	117	1,699	148	533	430	92
	Percentage									
Older engineers	93	88	92	94	94	92	93	95	98	96
Engineers born 1907–9	96	95	95	98	99	96	94	97	97	97
Engineers born 1910–14	95	94	95	94	94	94	88	97	97	98

[1] The data reported were primarily for men engaged in construction.
[2] Includes both graduates and "other" engineers who reported they were professionally active prior to 1930; all tabulated on year-of-birth basis.
[3] Includes both graduates and "other" engineers who reported they were professionally active in the year shown; all tabulated on year-of-birth basis.

The earnings shown in table 81 are those of engineers with 5 years or more of experience. The figures for public employment are essentially a breakdown among the 5 professional classes of the data shown in table 77 earlier in this chapter. They are presented here largely because it becomes possible to contrast the earnings of civil engineers, the most important group in public employment, with the earnings of civil engineers in the private-construction industry, for most of the engineers in public employment are engaged in construction. Thus, it may be noted that the lowest averages for civil engineers are in construction. State and county government employees average $205; Federal employees $221; and civil engineers in private construction $232.

In general, it may be said that among engineers with 5 years or more of experience State and county employment is at lower rates than Federal or municipal. This is true of the higher and lower levels of earnings, as well as of the average level. The Federal Government averages less than municipal governments for civil engineers and mechanical engineers, but more for electrical engineers. For these three types of engineers, public employment averages less than any of the fields of private employment except construction. Thus, civil

engineers averaged $234 per month in municipal employment and $232 in the private-construction industry, but ranged from $248 to $270 in other fields of private employment. Only in the case of chemical engineers do the rates in Federal employment exceed those received in the dominant field of private employment. Thus, chemical and ceramic engineers with the Federal Government averaged $300 per month in 1934 as against $296 in private manufacturing industries (and $285 in extractive industries).

TABLE 81.—*Comparison of 5 levels of monthly engineering earnings at end of 1934 of all older [1] engineers reporting field of engineering activity, by professional class*

Percentage of professional class at specified income levels	Monthly earnings in dollars by field of engineering activity								
	Private employment						Public employment [2]		
	Construction	Extractive industries	Public utilities	Transportation	Manufacturing	Personal service	Federal Government	State and county government	Municipal government
10 percent earned more than:									
Chemical and ceramic	(3)	(4)	(4)	(3)	668	604	(3)	(3)	(3)
Civil, agricultural, and architectural	468	529	477	496	488	496	375	335	402
Electrical	377	(4)	534	492	506	481	398	(4)	367
Mechanical and industrial	458	536	545	523	514	520	415	356	463
Mining and metallurgical	(5)	634	(3)	(5)	603	608	(4)	(3)	(5)
25 percent earned more than:									
Chemical and ceramic	(3)	420	367	(3)	433	434	(3)	(3)	(3)
Civil, agricultural, and architectural	316	388	362	357	344	370	288	258	308
Electrical	268	328	360	351	353	346	309	308	299
Mechanical and industrial	315	404	374	359	361	378	302	283	342
Mining and metallurgical	(3)	432	(3)	(5)	428	400	390	(3)	(3)
50 percent earned more than:									
Chemical and ceramic	310	285	249	320	296	306	300	167	253
Civil, agricultural, and architectural	232	270	251	256	248	269	221	205	234
Electrical	203	270	241	260	251	252	228	215	215
Mechanical and industrial	221	264	269	258	241	279	234	208	257
Mining and metallurgical	230	277	190	(5)	295	313	265	183	220
75 percent earned more than:									
Chemical and ceramic	(3)	195	200	(3)	196	215	(3)	(3)	(3)
Civil, agricultural, and architectural	170	200	190	199	189	207	165	162	188
Electrical	146	188	186	184	187	200	186	152	162
Mechanical and industrial	154	194	191	186	175	204	179	163	204
Mining and metallurgical	(3)	195	(3)	(5)	205	233	196	(3)	(5)
90 percent earned more than:									
Chemical and ceramic	(3)	(4)	(4)	(3)	145	143	(3)	(3)	(3)
Civil, agricultural, and architectural	128	149	148	161	145	160	142	140	151
Electrical	114	(4)	144	144	137	149	144	(4)	138
Mechanical and industrial	118	145	145	144	132	149	144	140	167
Mining and metallurgical	(3)	145	(3)	(5)	163	183	(4)	(3)	(3)

[1] Includes both graduate and "other" engineers who reported they were professionally active prior to 1930; all tabulated on year-of-birth basis.
[2] The data reported were primarily for construction. Thus, of 4,692 in Federal employment, 82 percent were so engaged. In State and county work and municipal government employ the proportions in construction were 95 and 97 percent, respectively.
[3] Fewer than 50 persons reported.
[4] Fewer than 100 persons reported.
[5] Fewer than 10 persons reported.

Within the various fields of private employment, average rates in the construction industry are low. This has already been shown to

be the case for civil engineers. It is quite as striking in the case of mechanical engineers and electrical engineers.[17]

Thus, in the case of chemical and ceramic engineers, while the highest median monthly earnings of $320 were received by men in transportation work, $310 per month were reported by those engaged in private construction. Similarly, for men of the same professional class in the employ of the Federal Government and in personal service, there was only a difference of $6 in the monthly earnings reported. The figures were, respectively, $300 and $306. The earnings of chemical and ceramic engineers in the employ of public utilities and those engaged on municipal government construction were practically the same. The latter figure of $253 a month was, however, less than that of $285 reported for extractive industries, while this in turn was exceeded by the earnings of $296 a month received by engineers engaged in manufacturing.

For mechanical and industrial engineers the median monthly earnings of $221 for private construction work were lower than those reported for Federal and municipal construction. The latter, however, did exceed the median monthly earnings of $241 of men engaged in manufacturing and were the same as those earned by mechanical and industrial engineers in the field of transportation. The range in earnings of the three other fields of engineering activity was from $264 for extractive industries to $279 for men engaged in personal service. In the case of mining and metallurgical engineers only public utilities' earnings were less than the three fields of construction work. Thus, while $190 a month were reported for the former, the range in the latter was from $220 for municipal construction to $265 for men engaged in Federal construction work. The earnings in the three remaining fields of engineering activity were greater, being $277 for extractive industries, $295 for manufacturing, and $313 for engineers of this professional class engaged in personal service.

From the preceding analysis of the 1934 median monthly earnings reported for fields of engineering activity it can be concluded that, except for contruction work, there were no marked differences in earnings opportunities for each professional class. However, subject to the qualification that these data are analyzed without regard to age, within each field the relative earnings of the five professional classes show distinct variation. Thus, in the five fields of private engineer-

[17] The fact that members of all 5 professional classes reported construction as a field of engineering activity has to be qualified. First, it is obvious, for example, that the numbers of opportunities for, say, chemical and ceramic engineers in construction are somewhat limited. Second, it has to be borne in mind that the field of engineering activity was requested only for the period Dec. 31, 1934. At that time there was a lack of opportunities in normal fields of engineering activity for all 5 professional classes. Hence, it is highly probable that for engineers in certain professional classes the fields of engineering activity reported were more of an accidental choice than a deliberate one, due to the conditions which prevailed at that particular time. Therefore, no special significance is to be attached to the fact that the few chemical engineers happened to average more than those in other fields of employment.

ing activity and in personal service, chemical and ceramic engineers, and mining and metallurgical engineers appear to have had a distinct advantage in earnings, whereas among the three other professional classes the differences in the median monthly earnings reported were not very great. Although a similar situation also prevailed at the two higher earnings levels, it will be noted that there was less spread in the earnings reported for public employment than in those received by engineers in the other fields of engineering activity. For example, while the median earnings of civil engineers in Federal employment were $221 a month, at the upper 10-percent earnings level the earnings received were $375 a month. By contrast, civil engineers in manufacturing received median monthly earnings of $248 a month and $488 a month at the upper 10-percent level.

TABLE 82.—*Comparison of medians of monthly engineering earnings at end of 1934 of all younger* [1] *engineers reporting field of engineering activity, by professional class*

Professional class	Monthly earnings in dollars by field of engineering activity								
	Private employment						Public employment [2]		
	Construction	Extractive industries	Public utilities	Transportation	Manufacturing	Personal service	Federal Government	State and county government	Municipal government
Engineers born 1907–9:									
Chemical and ceramic	(3)	125	112	(3)	114	95	130	(3)	(3)
Civil, agricultural, and architectural	138	146	135	151	142	148	150	140	140
Electrical	123	139	144	136	130	146	141	124	146
Mechanical and industrial	123	148	138	133	131	148	151	127	144
Mining and metallurgical	(3)	137	(3)	(3)	134	157	134	147	(3)
Engineers born 1910–14:									
Chemical and ceramic	(3)	151	138	(3)	141	130	150	(3)	(3)
Civil, agricultural, and architectural	118	132	108	142	114	113	134	118	127
Electrical	106	129	108	122	109	103	116	110	(3)
Mechanical and industrial	112	121	109	112	108	114	138	123	(3)
Mining and metallurgical	(3)	121	(3)	(3)	104	(3)	135	(3)	(3)

[1] Includes both graduate and "other" engineers who entered the profession during the years 1930–32 and 1933–34; all tabulated on year-of-birth basis.
[2] The data reported were primarily for construction work.
[3] Fewer than 10 persons reported.

At the lower 25-percent earnings level the data show no marked departure from those noted in the discussion of median earnings, except that the monthly earnings reported at this level for public employment were slightly higher than those reported by engineers engaged in private construction. This condition also occurred at the lowest earnings level with the exception that the earnings reported for public employment were practically the same as those received by engineers in each of the remaining fields of engineering activity. Likewise, for the earnings shown in table 82 for two groups of younger engineers, that is, those born in the years 1907–9 and 1910–14, the

monthly earnings received for public construction work were slightly greater than those received for private construction work. There was, however, very little difference in the earnings reported by each age group for public construction and those received in the other fields of engineering activity, except private construction.

Earnings by Type of Engineering Work

Those engineers who reported a field of engineering activity were also requested to indicate the type of work that they were engaged in within their particular field. The numbers so reporting are shown in table 83, while the earnings data of the older engineers are presented in table 84.

TABLE 83.—*Number of engineers reporting monthly engineering earnings at end of 1934, by type of engineering work*

Age group	Total	Type of engineering work						
		Design and research	Construction	Operation	Consulting	Teaching	Sales	General administration and management
	Number							
Older engineers: [1]								
Gross number reporting	24,822	6,425	6,070	4,942	1,859	1,816	1,233	2,477
Number reporting earnings	23,419	6,151	5,847	4,703	1,613	1,683	1,181	2,241
Engineers born 1907-9: [2]								
Gross number reporting	5,201	1,521	1,349	1,655	159	147	168	202
Number reporting earnings	5,068	1,488	1,312	1,613	156	141	163	195
Engineers born 1910-14: [2]								
Gross number reporting	4,078	1,104	817	1,676	128	87	112	154
Number reporting earnings	3,909	1,067	798	1,601	117	76	105	145
	Percentage							
Older engineers	94	96	96	95	87	93	96	90
Engineers born 1907-9	97	98	97	97	98	96	97	97
Engineers born 1910-14	96	97	98	96	91	87	94	94

[1] Includes both graduates and "other" engineers who reported they were professionally active prior to 1930; all tabulated on year-of-birth basis.
[2] Includes both graduates and "other" engineers who reported they were professionally active in the year shown; all tabulated on year-of-birth basis.

The data on rates of earnings are tabulated without regard to age, except for a break-down as between those engineers who were professionally active prior to 1930 and those who entered the profession in 1930 or later years. Among both groups the largest proportions were in design and research, construction, and operation. However, among the older group 10 percent were in general administration and management, about 7.5 percent in teaching and consulting, and 5 percent in sales, while among the younger groups the proportions are 4 percent in general administration, 3 percent in sales and consulting,

and 1.5 percent in teaching. It seems probable that these differences between the younger and older groups similarly exist within the older group.

TABLE 84.—*Comparison of 5 levels of monthly engineering earnings at end of 1934 of all older* [1] *engineers reporting type of engineering work, by professional class*

Percentage of professional class at specified income level	Monthly earnings in dollars by type of engineering work						
	Design and research	Construction	Operation	Consulting	Teaching	Sales	General administration and management
10 percent earned more than:							
Chemical and ceramic	577	(2)	512	(3)	(2)	592	(3)
Civil, agricultural, and architectural	365	352	406	540	478	484	587
Electrical	509	392	432	541	438	467	734
Mechanical and industrial	463	437	485	611	494	496	741
Mining and metallurgical	492	(3)	515	692	532	(2)	1,028
25 percent earned more than:							
Chemical and ceramic	418	(2)	371	516	(2)	400	699
Civil, agricultural, and architectural	278	271	304	361	363	330	426
Electrical	353	295	296	387	335	329	504
Mechanical and industrial	329	314	333	395	369	355	496
Mining and metallurgical	376	291	394	484	391	(2)	618
50 percent earned more than:							
Chemical and ceramic	285	213	253	345	320	307	483
Civil, agricultural, and architectural	218	211	226	260	274	255	312
Electrical	245	215	204	235	248	251	359
Mechanical and industrial	228	228	235	242	282	254	324
Mining and metallurgical	262	220	260	314	310	270	393
75 percent earned more than:							
Chemical and ceramic	203	(2)	175	223	(2)	217	310
Civil, agricultural, and architectural	169	164	176	188	216	195	225
Electrical	190	166	150	177	201	188	251
Mechanical and industrial	167	169	171	167	211	192	222
Mining and metallurgical	193	152	174	219	238	(2)	283
90 percent earned more than:							
Chemical and ceramic	151	(2)	136	(3)	(2)	144	(3)
Civil, agricultural, and architectural	140	141	141	140	176	145	171
Electrical	146	132	116	130	154	135	162
Mechanical and industrial	132	130	129	125	165	143	158
Mining and metallurgical	152	(3)	140	154	187	(2)	181

[1] Includes both graduate and "other" engineers who reported they were professionally active prior to 1930; all tabulated on year-of-birth basis.
[2] Fewer than 50 persons reported.
[3] Fewer than 100 persons reported.

The purpose of table 84 is to show the rates of earnings in 1934 of engineers with 5 years or more of experience in various types of work. In this comparison the engineers in general administration and management were, without any important exception, the best-paid group.[18] On the average, engineers engaged in general administration make from half again to twice as much as those engaged in design, construction, or operation. Thus, at the median-earnings level the range for chemical and ceramic engineers who reported monthly earnings was from $213 for construction [19] and $253 in operation to $483

[18] The contrast between general administration and design, construction, or operation would be heightened if the averages were diluted by the earnings of younger engineers.

[19] There were less than 50 chemical engineers engaged in construction. It is doubtful that the average is of any special significance.

for general administration and management. At this same earnings level the corresponding figures for the upper and lower extremes in the case of mechanical and industrial engineers were $228 and $324, or a range of $96.

Consulting,[20] teaching, and sales in all instances averaged less than administration and generally averaged more than design, construction and operation. In the case of electrical engineering, the average rate in design and research was $10 higher than in consulting and a few dollars less than in teaching and sales; all of these four classes of work were substantially above construction and operation. The average rate for teaching was generally higher than for sales and consulting, a relationship that held also as regards the earnings of the lowest 10 and 25 percent. At the level of earnings of the upper 10 and 25 percent, consulting yielded more than sales and teaching.

In all professional groups, except electrical engineering, higher rates were paid in design and research and in operation than in construction. Among electrical engineers the highest-paid 10 percent engaged in operation also received more than the highest 10 percent in construction, but at the lower earnings levels construction paid more. In the case of civil engineers and mechanical engineers, there was relatively little difference in average rates of pay for these three functions. For example, at the median-earnings level, civil engineers engaged in construction received $211 a month, while members of this same professional class engaged in design and research and in operation received, respectively, $218 and $226 a month. Furthermore, mining engineers averaged nearly the same in design and research as in operation. In the case of both chemical and ceramic engineers and electrical engineers, those engaged in design and research averaged more than those engaged in operation, and at the higher levels of earnings the differences between them were even more marked.

In regard to differences in earnings within each type of work, it will again be noted that, except for construction, chemical and ceramic engineers, and mining and metallurgical engineers had the advantage. Thus, the former professional class reported median monthly earnings of $285 for design and research; the latter received $262 a month. The range in monthly earnings for the three other professional classes was from $218 to $228.

Due to the variations in spread, these differences in earnings became accentuated at the two higher-earnings levels. For example, while mining and metallurgical engineers reported median monthly earnings of $393 for general administration and management, one-quarter received not less than $618 a month and one-tenth not less than $1,028 a month. By contrast, the corresponding figures for civil engineers

[20] In the present table, "consulting" includes reports from independent consultants and from employees of private firms whose function is to act as consultants.

engaged in the same type of work were $312, $426, and $587 a month. Although the spread in earnings for consulting was less than that noted for general administration and management, it was relatively greater than that which occurred in any of the other types of work. The smallest spread occurred in the earnings reported for construction. Thus, electrical engineers in this field had median monthly earnings of $215, but at the upper 10-percent earnings level they were only $392.

TABLE 85.—*Comparison of medians of monthly engineering earnings at end 1934 of all younger*[1] *engineers reporting type of engineering work, by professional class*

Professional class	Monthly earnings in dollars by type of engineering work						
	Design and research	Construction	Operation	Consulting	Teaching	Sales	General administration and management
Engineers born 1907–9:							
Chemical and ceramic	152	141	134	150	130	167	160
Civil, agricultural, and architectural	146	143	145	144	143	144	156
Electrical	146	138	134	119	145	140	143
Mechanical and industrial	134	130	130	133	158	149	138
Mining and metallurgical	145	143	133	135	(2)	(2)	(2)
Engineers born 1910–14:							
Chemical and ceramic	121	115	112	125	(2)	(2)	(2)
Civil, agricultural, and architectural	125	124	126	121	110	(2)	136
Electrical	114	105	108	117	113	108	129
Mechanical and industrial	112	118	110	112	113	108	110
Mining and metallurgical	113	118	112	(2)	(2)	(2)	(2)

[1] Includes both graduate and "other" engineers who entered the profession during the years 1930–32 and 1933–34; all tabulated on year-of-birth basis.
[2] Fewer than 10 persons reported.

Although the preceding analysis does evidence a somewhat steep gradation in earnings by type of work for each professional class, it should again be emphasized that these should be considered in relation to the earnings opportunities within each of the types of work reported. Obviously, the possibilities in general administration and management were very small. They were also relatively smaller for teaching and consulting. On the other hand, in the four other types of work shown, the numbers of opportunities available were relatively much greater.

In addition to the numbers of available opportunities in each type of work, the effects of age and experience should also be borne in mind. The influence of the last two factors is made evident by considering the median-earnings data for two younger groups of engineers presented in table 85. These show that in all types of engineering work younger engineers start with practically the same level of earnings.

Earnings by Geographical Division

In the preceding analyses of monthly engineering earnings the data were dealt with on a national basis. Consideration will now be given to determine what variations obtained in the rates of monthly compensation received by engineers located in different geographical divisions throughout the country.

For these purposes the only data compiled on a regional basis were those reported by older [21] graduate and "other" or nongraduate engineers in the three major professional classes of civil,[22] electrical,

TABLE 86.—*Number of older graduate and "other" engineers reporting monthly engineering earnings in 1929, 1932, and 1934, by region*

[Without regard to kind of engineering employment reported]

Professional class by region	Number reporting								Percentage reporting earnings	
	Graduate engineers				"Other" engineers				Graduate engineers	"Other" engineers
	Education	Earnings			Education	Earnings				
		1929	1932	1934		1929	1932	1934	1929	1929
Civil, agricultural, and architectural										
United States	10,318	9,064	8,216	8,593	4,341	3,856	3,500	3,691	87.8	88.8
New England	777	659	601	643	290	259	238	247	84.8	89.3
Middle Atlantic	2,389	2,081	1,810	1,822	951	846	736	761	87.1	89.0
District of Columbia	313	279	273	283	67	61	61	61	89.1	91.0
East North Central	1,761	1,536	1,360	1,409	566	484	415	440	87.2	85.5
South Atlantic	848	716	659	712	405	356	333	350	84.4	87.9
East South Central	341	302	269	301	97	88	82	86	88.6	90.7
West South Central	535	476	452	480	160	135	128	138	89.0	84.4
West North Central	1,161	1,032	979	1,020	498	455	436	455	88.9	91.4
Mountain	546	473	439	480	318	275	255	289	86.6	86.5
Pacific	1,647	1,510	1,374	1,443	989	897	816	864	91.7	90.7
Electrical										
United States	5,184	4,406	4,060	4,003	1,285	1,098	998	980	85.0	85.4
New England	431	356	342	341	115	89	76	75	82.6	77.4
Middle Atlantic	1,961	1,711	1,604	1,562	444	384	343	332	87.3	86.5
District of Columbia	95	75	71	75	25	22	21	23	78.9	88.0
East North Central	1,050	897	809	793	279	246	219	215	85.4	88.2
South Atlantic	376	287	255	252	87	77	72	71	76.3	88.5
East South Central	115	102	94	96	27	21	19	18	88.7	77.8
West South Central	167	146	132	136	40	33	32	31	87.4	82.5
West North Central	412	341	312	305	85	71	67	66	82.8	83.5
Mountain	137	115	102	100	50	39	35	39	83.9	78.0
Pacific	440	376	339	343	133	116	114	110	85.5	87.2
Mechanical and industrial										
United States	6,599	5,539	4,492	5,105	2,407	2,029	1,773	1,882	83.9	84.3
New England	597	483	434	450	226	187	170	173	80.9	82.7
Middle Atlantic	2,435	2,068	1,809	1,837	838	705	604	649	84.9	84.1
District of Columbia	115	106	101	103	29	26	26	26	92.2	89.7
East North Central	1,558	1,316	1,160	1,216	668	586	502	539	84.5	87.7
South Atlantic	497	383	347	357	131	104	99	100	77.1	79.4
East South Central	142	119	113	121	49	36	31	33	83.8	73.5
West South Central	253	214	206	214	63	50	47	46	84.6	79.4
West North Central	382	321	297	308	143	115	106	111	84.0	80.4
Mountain	115	112	99	104	48	42	34	39	97.4	87.5
Pacific	505	417	376	395	212	178	154	166	82.6	84.0

[21] Those engineers who reported they were professionally active prior to 1930.

[22] Also includes agricultural and architectural engineers.

and mechanical [23] engineering. The figures in table 86 show that reports on earnings were furnished by more than 300 graduate civil engineers in each of the 10 geographical divisions for 1929. The sample of mechanical and electrical engineers is smaller, but for virtually any division at least 100 reports are available. In general, there were reports on income from about five-sixths of the engineers, though the percentage of returns from New England and the South Atlantic States is persistently slightly below the average.

At this point it is pertinent to note that since the regional data were compiled without regard to employment status reported, the base of reference for the percentages of returns is the type of education reported and not the kind of engineering work engaged in.

The choice of this particular base for 1929, however, is warranted. First, in that year the number of unemployed engineers was less than 1 percent; second, even if allowance had been made for those men engaged in nonengineering work, the general relationships for the percentages shown would not be vitally affected. The adequacy of the regional data can, however, be gauged from the data presented in the ensuing discussion of earnings by size of city. These earnings are shown related to men engaged in engineering work and range from 88.7 percent for men employed in Cincinnati, Ohio, to 94.8 percent for Newark, New Jersey.

The monthly rates of compensation reported from engineering work of graduates and "other" or nongraduate engineers in these three professional classes are presented in table 87 without regard to age.

In 1929 there were persistent differences in the average rates of pay of three types of engineering. Graduate mechanical engineers in 1929 averaged higher than electrical or civil engineers in all divisions, except in the District of Columbia. The spread within the regions differed substantially, however. Thus, among the graduates the greatest ranges were $46, which occurred in the New England area, and $56 in both the East North Central and West South Central divisions. The smallest ranges, namely $8 and $11, occurred, respectively, in the Pacific and Mountain regions. Within the other five regions the extremes in the median earnings varied from $22 in the Middle Atlantic division to $36 in the East South Central States. In all regions except New England, electrical engineers earned less than civil engineers. In the Mountain States and the Pacific States there was an over-all spread of only about $10 among the three classes. In three other regions—New England, South Atlantic, and East South Central States—the difference between graduate civil and electrical engineers was less than $10.

[23] Also includes industrial engineers.

TABLE 87.—*Comparison of median monthly engineering earnings in 1929, 1932, and 1934 of all older graduates [1] and "other" engineers [2] reporting, by region*

[Without regard to kind of engineering employment reported]

Region	1929			1932			1934		
	Civil, agricultural, and architectural	Electrical	Mechanical and industrial	Civil, agricultural, and architectural	Electrical	Mechanical and industrial	Civil, agricultural, and architectural	Electrical	Mechanical and industrial
	Older graduate engineers [1]								
New England	$271	$280	$317	$238	$262	$292	$222	$266	$276
Middle Atlantic	318	297	319	275	268	274	238	269	254
District of Columbia	316	291	293	308	277	276	300	239	273
East North Central	307	270	326	250	244	270	230	242	254
South Atlantic	265	261	284	227	238	248	199	231	242
East South Central	259	256	292	223	227	241	219	221	239
West South Central	290	253	309	263	223	270	238	209	259
West North Central	263	249	276	233	227	235	220	224	218
Mountain	245	239	250	226	222	225	225	231	227
Pacific	275	269	277	240	246	240	237	239	227
	Older "other" engineers [2]								
New England	$238	$269	$305	$221	$251	$264	$210	$235	$246
Middle Atlantic	286	295	329	244	255	271	209	238	236
District of Columbia	294	360	300	273	268	250	258	237	274
East North Central	276	279	326	223	233	266	201	225	235
South Atlantic	254	249	323	216	209	270	197	209	274
East South Central	246	245	344	206	190	273	207	200	254
West South Central	294	238	308	257	226	238	233	228	225
West North Central	228	258	299	210	256	240	190	240	227
Mountain	217	247	256	192	233	207	185	237	190
Pacific	259	257	296	227	233	254	218	224	230
	Percentage income of "other" engineers formed of that of graduate engineers								
New England	88	96	96	93	96	90	95	88	89
Middle Atlantic	90	99	103	89	95	99	88	88	93
District of Columbia	93	124	102	89	97	91	86	99	100
East North Central	90	103	100	89	95	99	87	93	93
South Atlantic	96	95	114	95	88	109	99	90	113
East South Central	95	96	118	92	84	113	95	90	106
West South Central	101	94	100	98	101	88	98	109	87
West North Central	87	104	108	90	113	102	86	107	104
Mountain	89	103	102	85	105	92	82	103	84
Pacific	94	96	107	95	95	106	92	94	101

[1] Includes all postgraduates, nonengineering graduates, and first-degree engineering graduates who reported they were professionally active prior to1930.

[2] Includes all engineers with college course incomplete, and those with noncollegiate technical school and secondary-school education.

Between 1929 and 1934 the average rates of graduate electrical engineers fell less than those of civil engineers. In only two regions—District of Columbia and the West North Central States—did electrical engineers average less than the two other professional groups. In the Middle Atlantic States they averaged more than mechanical engineers, as was also the case in three regions—West North Central,

Mountain, and Pacific States—where earnings in the various professional groups were all more or less alike.

The differences in rates as among the various regions are not consistent from one group to the next, nor from one year to another. However, the Middle Atlantic States and the District of Columbia appear in general to be slightly above New England and the East North Central States. This is especially the case among civil engineers. These four regions are generally above the Pacific States and the West South Central States, both of which rank fairly high as regards earnings of civil engineers. Electrical engineers are as high in the Pacific States as in the East North Central; in 1934 especially, mechanical engineers in the West South Central States ranked high as regards average earnings. In general, the lowest average rates were reported from the Mountain States and the West North Central, though the differences between the averages in these regions, and those in the South Atlantic and East South Central States are not consistent.

Earnings by Size of City

In addition to obtaining data by region, an analysis was also made to determine what effects size of city had upon the earnings opportunities of professional engineers. These data were, however, tabulated only for the years 1929 and 1934 for 18 individual cities and groupings of 4 others by size of population. From the data in table 88 it will be noted that approximately 90 percent of the engineers reporting furnished their income data. The corresponding figures of earnings on an adjusted basis are shown in table 89.

As regards average earnings in 1929 there was an extreme range among the cities with a population of 400,000 or more from about $280 per month for Los Angeles, Minneapolis, and St. Paul to $351 for Pittsburgh. Pittsburgh also had the highest average in 1934; the lowest average rates were in Milwaukee, Buffalo, and Cincinnati. The extreme differences in rates as among cities appear large, being equivalent in 1929 to $1,056 per year. But in general the averages seem to depend upon local conditions of employment. The largest of these cities do not have the highest average. Cities in one section of the country are not regularly higher than those in other sections. Rather, widely separated and dissimilar cities have often almost identical earnings. The order of the cities changed sharply from 1929 to 1934.

TABLE 88.—*Comparison of total number of engineers reporting engineering employment and total number reporting monthly engineering earnings in 1929 and 1934, by size of city*

[Figures adjusted as explained on p. 34 and without regard to kind of engineering employment reported]

City	All engineers					
	1929			1934		
	Total number reporting	Total reporting income	Percentage reporting income	Total number reporting	Total reporting income	Percentage reporting income
Total	29,207	27,124	92.9	31,846	29,806	93.6
New York	2,977	2,744	92.2	2,557	2,362	92.4
Chicago	1,395	1,291	92.5	1,317	1,214	92.2
Philadelphia	636	586	92.1	660	607	92.0
Detroit	485	433	89.3	522	475	91.0
Los Angeles	979	921	94.1	983	915	93.1
Cleveland	454	409	90.1	518	467	90.2
St. Louis	340	317	93.2	388	366	94.3
Baltimore	201	178	88.6	236	210	89.0
Boston	351	329	93.7	371	347	93.5
Minneapolis and St. Paul	503	462	91.8	554	514	92.8
Pittsburgh	467	435	93.1	462	428	92.6
San Francisco	513	478	93.2	535	501	93.6
Milwaukee	289	267	92.4	307	282	91.9
Buffalo	118	108	91.5	158	148	93.7
Washington	644	600	93.2	718	676	94.2
New Orleans	140	129	92.1	168	156	92.9
Cincinnati	222	197	88.7	273	241	88.3
Newark	191	181	94.8	189	176	93.1
Population 100,000 to 400,000	5,161	4,785	92.7	5,878	5,496	93.5
Population 50,000 to 100,000	2,613	2,437	93.3	2,914	2,757	94.6
Population 10,000 to 50,000	4,962	4,639	93.5	5,652	5,344	94.6
Population under 10,000	5,566	5,198	93.4	6,486	6,124	94.4

There does appear to be some relationship between city size and average rates. None of the 18 cities of 400,000 or more in 1934 and only two in 1929 had average earnings materially lower than the average in the smaller cities. By and large, the cities of 400,000 or more appeared to pay $200 to $250 more per year than cities of 50,000 to 400,000. These in turn averaged about $100 more than cities of 10,000 to 50,000; and these, about $200 more than was paid in communities of less than 10,000.

A situation similar to that noted for average earnings reported also occurred at the two lower earnings levels. But the concentration of opportunities for higher earnings in the larger cities is fairly well defined at the upper 25-percent level and more so at the upper 10-percent earnings level. Thus, the highest earnings reported in 1929 at the upper 10-percent level were those of engineers in the city of Philadelphia, who reported not less than $765 per month. These earnings were only slightly higher than those reported for Boston. In Cleveland and New York 10 percent of the engineers received not less than $755 and $750 per month. Next in order came Detroit, Chicago, Pittsburgh, and Buffalo, where earnings at the upper 10-percent level ranged from $704 to $729 per month.

TABLE 89.—*Comparison of 5 levels of monthly engineering earnings in 1929 and 1934 of all engineers*[1] *reporting engineering employment, by size of city*

[Figures adjusted as explained on p. 34 and without regard to kind of engineering employment reported]

City[2]	Proportion with annual earnings of more than specified amount										Percentage decrease 1929–34				
	10 percent	25 percent	50 percent	75 percent	90 percent	10 percent	25 percent	50 percent	75 percent	90 percent	10 percent	25 percent	50 percent	75 percent	90 percent
	1929 income in dollars					1934 income in dollars									
Philadelphia	765	488	329	233	178	509	357	238	165	123	33	27	28	29	31
Boston	761	482	317	220	167	563	349	248	167	118	26	28	22	24	29
Cleveland	755	504	335	242	187	511	346	230	155	119	32	31	31	36	36
New York	750	488	320	238	187	613	395	253	171	124	18	19	21	28	34
Detroit	729	486	341	257	195	500	363	249	169	130	31	25	27	34	33
Chicago	721	488	326	240	188	518	352	237	159	121	28	28	27	34	36
Pittsburgh	713	498	351	271	209	511	388	269	193	130	28	22	23	29	38
Buffalo	704	480	329	223	174	482	310	215	143	114	32	35	35	36	34
Baltimore	676	445	299	223	163	503	333	228	147	110	26	25	24	34	33
Cincinnati	653	434	308	228	159	420	304	214	145	107	36	30	31	36	33
Newark	652	435	308	218	154	459	320	228	158	119	30	26	26	28	23
St. Louis	634	458	319	228	171	487	353	228	160	116	23	23	29	30	32
Milwaukee	615	426	293	219	161	429	321	216	145	108	30	25	26	34	33
New Orleans	615	427	305	222	145	432	323	225	157	124	30	24	26	29	14
Population 100,000 to 400,000	602	410	287	214	163	436	310	216	152	117	28	24	25	29	28
Population 50,000 to 100,000	579	408	292	218	166	425	309	216	155	118	27	24	26	29	29
San Francisco	576	401	291	224	184	487	343	247	191	145	15	14	15	15	21
Washington, D. C	551	427	312	230	174	487	388	267	194	151	12	9	14	16	13
Los Angeles	543	386	280	223	192	423	302	224	177	135	22	22	20	21	30
Population 10,000 to 50,000	536	403	282	212	164	416	291	207	149	114	22	28	27	30	30
Population under 10,000	503	355	263	203	156	377	267	194	144	112	25	25	26	29	28
Minneapolis and St. Paul	494	375	279	213	182	399	297	220	164	128	19	21	21	23	30

[1] Includes both graduates and "other" engineers; all tabulated on year-of-birth basis.
[2] Arranged in ascending order of incomes reported at upper 10-percent level for 1929.

In only three of the cities with 400,000 population or more did the upper 10 percent of the engineers earn less than was earned at this level ($602) in cities of 100,000 to 400,000. In cities with less than 10,000 population the upper 10 percent earned $503 or more in 1929. Similar differences obtained in 1934.

Over the period 1929–34 the earnings at all income levels and for all cities declined. The average rates paid declined about equally from 1929 to 1934 in communities of different sizes. At the average earnings level the smallest declines were reported for the cities of San Francisco and Washington, D. C., in which the percentages of decrease were, respectively, 15 and 14. But for the remaining cities the decreases ranged from 20 percent in the case of Los Angeles to as high as 31 percent for the city of Cincinnati. In general, greater declines than those noted for average earnings occurred at the two lower earnings levels, while those for the two upper earnings levels were smaller.

These data are also shown for two age groups in tables 90 and 91. For engineers born prior to 1907 and who were, therefore, professionally active in 1929, the declines in earnings were practically the same at all five earnings levels. As for the younger engineers, it will be noted that there was almost no variation in their earnings by size of city. As between individual cities, there was a spread at the average level of approximately the same proportion as was noted in the averages for all engineers.

TABLE 90.—*Comparison of 5 levels of monthly engineering earnings in 1929 and 1934 of all engineers [1] born prior to 1907 reporting engineering employment, by size of city*

[Without regard to kind of engineering employment reported]

City [2]	Proportion with annual earnings of more than specified amount										Percentage increase or decrease, 1929–34				
	10 percent	25 percent	50 percent	75 percent	90 percent	10 percent	25 percent	50 percent	75 percent	90 percent	10 percent	25 percent	50 percent	75 percent	90 percent
	1929 income in dollars					1934 income in dollars									
Philadelphia	765	488	329	233	178	537	383	265	193	145	−30	−22	−19	−17	−19
Boston	761	482	317	220	167	601	365	273	198	141	−21	−24	−14	−10	−16
Cleveland	755	504	335	242	187	540	394	261	184	146	−28	−22	−22	−24	−22
New York	750	488	320	238	187	633	415	274	194	141	−16	−15	−14	−18	−25
Detroit	729	486	341	257	195	514	397	275	193	145	−29	−18	−19	−25	−26
Chicago	721	488	326	240	188	544	374	258	185	141	−25	−23	−21	−23	−25
Pittsburgh	713	498	351	271	209	520	401	286	210	155	−27	−19	−19	−23	−26
Buffalo	704	480	329	223	174	517	364	250	191	141	−27	−24	−24	−14	−19
Baltimore	676	445	299	223	163	531	360	254	191	142	−21	−19	−15	−14	−13
Cincinnati	653	434	308	228	159	435	327	245	179	126	−33	−25	−20	−21	−21
Newark	652	435	308	218	154	493	352	253	196	142	−24	−19	−18	−10	−8
St. Louis	634	458	319	228	171	517	391	258	193	142	−18	−15	−19	−15	−17
Milwaukee	615	426	293	219	161	436	334	232	158	122	−29	−22	−21	−28	−24
New Orleans	615	427	305	222	145	456	342	249	183	147	−26	−20	−18	−18	+1
Population 100,000 to 400,000	602	410	287	214	163	468	332	235	176	138	−22	−19	−18	−18	−15
Population 50,000 to 100,000	579	408	292	218	166	442	329	236	178	142	−24	−19	−19	−18	−14
San Francisco	576	401	291	224	184	494	349	255	201	152	−14	−13	−12	−10	−17
Washington, D. C	551	427	312	230	174	497	402	284	214	166	−10	−6	−9	−7	−5
Los Angeles	543	386	280	223	192	433	309	231	186	146	−20	−20	−18	−17	−24
Population 10,000 to 50,000	536	403	282	212	164	440	313	227	172	136	−18	−22	−20	−19	−17
Population under 10,000	503	355	263	203	156	408	290	216	161	131	−19	−18	−18	−21	−16
Minneapolis and St. Paul	494	375	279	213	182	408	308	230	185	145	−17	−18	−18	−13	−20

[1] Includes both graduates and "other" engineers; all tabulated on year-of-birth basis.
[2] Arranged in ascending order of incomes reported at upper 10-percent level for 1929.

TABLE 91.—*Comparison of 5 levels of monthly engineering earnings in 1934 of all engineers* [1] *born 1907–14 reporting engineering employment, by size of city*

[Without regard to kind of engineering employment reported]

City	Proportion with annual earnings of more than specified amount				
	10 per-cent	25 per-cent	50 per-cent	75 per-cent	90 per-cent
	1934 income in dollars				
Philadelphia	196	163	133	108	89
Boston	(2)	147	118	101	(2)
Cleveland	175	148	126	106	88
New York	197	165	135	110	89
Detroit	193	168	138	120	96
Chicago	187	156	130	108	89
Pittsburgh	(2)	145	124	108	(2)
Buffalo	(2)	154	129	105	(2)
Baltimore	(2)	138	115	98	(2)
Cincinnati	192	152	125	105	89
Newark	(2)	158	127	100	(2)
St. Louis	184	157	132	103	86
Milwaukee	(2)	132	113	95	(2)
New Orleans	(2)	158	128	105	(2)
Population 100,000 to 400,000	181	154	130	106	88
Population 50,000 to 100,000	176	151	128	106	88
San Francisco	(2)	169	145	112	(2)
Washington, D. C	210	177	155	127	95
Los Angeles	179	154	134	111	91
Population 10,000 to 50,000	177	151	126	103	86
Population under 10,000	175	152	129	106	87
Minneapolis and St. Paul	173	147	126	105	87

[1] Includes both graduate and "other" engineers; all tabulated on year-of-birth basis.
[2] Fewer than 100 persons reported.

Chapter X

Limitations of the Data for Prediction Purposes

In the preceding analysis there has been presented a comprehensive picture of the activities of professional engineers, as well as the earnings derived from these activities. In regard to the latter it cannot be too strongly emphasized that these data relate only to what engineers of various ages were earning in 1929, 1932, and 1934. Since there are no better data available, it is almost inevitable that the figures will be used to predict what young engineers may expect to earn 10 or 15 years hence. For that reason, it is important to emphasize the severe limitations which attach to the data in this connection.

The first point—that the general level of engineering income fluctuates from year to year—needs merely to be mentioned in passing. Therefore, the absolute level of incomes for engineers with any given amount of experience cannot be forecast for any future year.

The chief danger to be guarded against is the assumption that the income relationships for 1934 will hold in some future year. A cautious use of such information may add to the value of the advice of those who are directing young men into the various fields of specialization. A careless assumption that this same relationship will hold 20 years hence for future graduates will make the resulting advice dangerous.

The tabulations show merely the facts of the income distribution in 1934 or some other particular year. For example, chemical and ceramic engineers 20 years after graduation averaged $4,100 and one-quarter of such engineers earned more than $6,000. On the other hand, civil engineers 20 years after graduation averaged $3,100 and the best-paid quarter averaged only $4,100 or more. It is evident, therefore, that men graduating from college in 1914 advanced on the whole to higher levels of income if their college work had been in the field of chemical or ceramic engineering than if it had been in the field of civil engineering. This much is fact.

But it must not be concluded from these data on income alone that it is wise to encourage men entering college in 1940 to specialize in chemical and ceramic engineering and to discourage their entering the field of civil engineering. Such advice will be sound only if the conditions surrounding the two fields of engineering and their prospects for the next 20 years are similar to the conditions of 1914 to

1934. Years of experience are themselves a factor in determining what kind of engineers are available. It is quite possible that there may be a relative scarcity of engineers with a given type of academic background and with 20 years of experience, while at the same time the supply of younger engineers with that same type of formal education may have become excessive. It is quite easy to see that a special scarcity value may have attached in 1934 to chemical engineers that did not accrue to civil engineers graduating in 1914. There was a tremendous expansion of the chemical industry in the United States during and following the 1914–18 World War. It is a matter of common knowledge that such enterprises had the greatest difficulty in finding sufficient men with the requisite education and experience. On the other hand, while there are more civil engineers and more jobs for civil engineers than in 1914, a decrease in certain types of civil engineering work—as, for example, the construction of new railroads—has acted to restrain the development of relative scarcity values such as may have attached to chemical engineers.

At the same time it is impossible to make a comparison of the earnings of the younger engineers in the several professional classes and to conclude that the relationship between the professional groups will hold when they have had 20 years' experience. Thus in 1934 we find that chemical and ceramic engineers who graduated in 1932 averaged $1,286, whereas civil and mechanical engineers averaged $1,384. The statistics do not preclude the possibility that there is a longer period of apprenticeship for some types of engineering work than for others and that, following such a period of apprenticeship, there may be a more rapid advancement in the one line than in the other, ultimately to a higher level of income.

Conclusions as to the relative desirability of entering one type of engineering rather than another should be drawn only by those with an intimate acquaintance with all fields of engineering. Available statistics are probably a less satisfactory basis for advice than would be the pooled nonstatistical judgments of a number of people with a wide knowledge of the engineering profession and its opportunities. The statistical materials of this study can be used safely in projection only to fortify the judgments and forecasts of such individuals. To those who know not only the present situation of the various professional groups but also the changing background of those professions over the past few decades, the income data will have particular significance. One who knows how the supply of and demand for particular types of engineering training has changed can make allowances and may attempt to estimate the most probable changes in future relationships. He will be helped to appraise the state of the current market for engineering services, by the earlier chapters of this report,

in which has been indicated the extent to which recent engineering graduates have been able to find engineering jobs.

The statistics which are presented here have a value that varies with the richness of the background of the user. Educational advisers and directors are performing specialized work and by the very nature of their work must guess what the future holds in store for various professions. Their prognosis becomes better if it is based on an extensive and accurate knowledge of existing conditions. This basis of knowledge the Bureau supplies on a larger scale than previously available. The Bureau has attempted as comprehensive an analysis of recently existing relationships as its resources permit, and will welcome further critical analysis from any source of the detailed materials.

The Bureau has carefully refrained from describing differences in the average incomes of graduate and nongraduate engineers as a measure of the value of a completed college course in engineering. From the data in hand, it is impossible to determine whether the differences are due to the fact that given individuals have received a college education or to other factors. It is possible that the differences in income arise from an initial process of selection. It is also possible that a prejudice in favor of the college graduate affords him better opportunities to acquire valuable experience than are given to the noncollege graduate. In such case, the advantages would arise not from formal education which the man had received but from his status as a college graduate.

It is a matter of common belief that college training has economic value for the prospective engineer. The figures in this study support this belief but cannot be taken as conclusive proof. Rather more conclusively they prove the great importance of other factors in addition to formal education. If formal education is an asset, the young graduate engineer should advance more rapidly than the nongraduate of corresponding age. This does happen. The data thus furnish supporting evidence as to the value of a formal education. But were formal education an all-important element in determining income in these early years, there should come a point at which no further relative spread developed between the average earnings of college graduates and nongraduates.

The facts show that the spread does increase. The difference is greater both in absolute terms and in relative terms after 30 or 40 years of experience than it is after 10 or 15 years of experience. This increased spread not only is noted with reference to the average of the two classes but applies at the five levels that have been studied. It was found not only in 1929 but also in 1932 and 1934.

It can hardly be argued that the scholastic background of engineers who entered the profession in 1900 is a controlling factor with refer-

ence to their earnings in 1929 and 1934. Certainly, the value of their services is no longer primarily dependent upon the odds and ends of information which they acquired in college, although it is possible that habits of thinking and study which the engineer received in his college days constitute a permanent legacy. By and large the factors controlling the value of a man's engineering services after 30 years or more of experience must be primarily his native capacity and the training which he has received on the various jobs that he has performed.

As regards native capacity, there is reason to believe that, on the average, better material will be found among college graduates than among those who failed to complete a college course. There are of course many individuals who are unable to complete an engineering course for financial reasons. There are also many individuals of limited capacity who receive degrees. But there is also a wholesale process of weeding out that goes on in the engineering schools. Thus even the differences in income shown in the earliest years of experience may reflect differences in capacity rather than differences arising from the value of the formal training.

Whether ability is more important than the differences in the kinds of experience that are open to the college graduate and the nongraduate, it is impossible to tell. It is a matter of common knowledge that for a number of years college education has been thought of as a normal prerequisite to engineering work. A number of large employers of engineers deliberately differentiate between the college graduate and the nongraduate, offering the young engineer with a college education opportunities for training on the job which either are not available to the nongraduate or are open to him after special consideration rather than as a matter of routine.

It must be noted that this latter type of advantage will tend increasingly to accrue to the status of the graduate as opposed to the nongraduate. In this sense status is gained by graduation, to some extent no longer with regard to the value of the formal education as such. The more common a college education becomes, and the more widespread the assumption of a difference in capacity between the college graduate and the nongraduate becomes, the more certain it is that employers will discriminate in favor of the college graduate. Such discrimination means that the college graduate will generally be given more favorable opportunities for training on the job than the nongraduate of equal capacity.

It is known, however, that many large employers of young engineers have already developed a highly selective process of employment in interviewing candidates from engineering colleges. They may assume that in general college graduates are more promising material than nongraduates. They no longer recognize the mere fact

of graduation as evidence of employability and give special status only to those who graduate with a standing substantially better than the average of the class. Thus the advantage of status which may have accrued a number of years ago through the fact of college graduation alone now accrues in equal measure only to graduation with exceptional standing.

The candidate for a position in the engineering profession should study carefully the tables not only for average earnings but also for the upper and lower 10 and 25 percent of the engineers. Table 54 of chapter VIII shows clearly that a young man is well advised to enter the profession after successfully completing a period of formal education beyond the high-school level. The earlier chapter on education indicated that college training was coming to be a prerequisite for entrance to the profession. But it is unwise to rely heavily on the value of a college education *per se*.

The present study gives conclusive demonstration of differences of income which generally reflect different degrees of capacity. The lot of the college graduate may be somewhat easier than that of the nongraduate. But even in 1929 the lowest 10 percent of the college graduates in civil engineering were earning less than $2,500 after 10 years of experience, with $2,700 after 20 years of experience. These figures are to be compared with the average earnings of $3,600 and $4,400 for these respective groups. On the other hand, the upper 10 percent of the civil engineers whose college course was incomplete earned $5,200 or more after 10 years of experience and $7,600 or more after 20 years of experience. The upper 10 percent of the engineers with only a secondary-school education similarly showed earnings substantially above those of the average college graduate. In other words, graduation from an engineering school is no guaranty of a satisfactory income, while there is still apparently an opportunity for a man of outstanding capacity to secure far better than an average engineering income even though he has not attended college.

The most significant differences in income revealed by the present survey are not the differences in the average income received by individuals who have received a college degree and those who have not. Nor are they the differences as between individuals who have entered one professional class rather than another. These differences on the whole are moderate, though they are large enough to prove the desirability of choosing well both the field of endeavor and the type of training best adapted to advancement in that field. The most striking differences are those which exist within each profession and within each group classified on the basis of its educational background. One out of 10 of the engineers in each such group secured an income several times as great as the average for the group as a whole. At least one out of 10 at the bottom of each such group, whether a college

graduate or not, whether a chemical engineer or a civil engineer, whether a man with many years of service or freshly out of college, is hardly to be distinguished as regards income from a skilled wage earner.

It is impossible to forecast from these data what the future holds in store for the high-school boy who must be advised as to what type of training will be most advantageous. But it may be pointed out that in 1929 the average income of graduate engineers with 10 years' experience ranged from $3,600 to $4,600 in the various professional classes. In 1929 only 6.4 percent of the incomes in the United States exceeded $4,000. Furthermore, engineering is a profession in which earning capacity advances and is sustained until late in life. But if in these respects the profession appears attractive on the average, its rewards are not particularly attractive to the poorer or less fortunate engineers. Even in 1929 the lowest-paid 10 percent of the engineers could hope for no more than $2,500 to $3,000, though they might stay in the profession for 40 years. In 1934, exposed as the profession was to the risks of unemployment, the lowest-paid 10 percent of the engineers with less than 5 years' experience after graduation earned less than $1,000. Even with 10 to 30 years' experience they earned no more than $1,000 to $1,500. Judged from the basis of money income, there can be no question but that the best of a group of skilled wage earners are in a better economic position than those who struggle to maintain a position on the fringes of the engineering profession.

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Appendix A

Facsimile of Questionnaire

B. L. S. 948 — STRICTLY CONFIDENTIAL

U. S. DEPARTMENT OF LABOR
BUREAU OF LABOR STATISTICS
WASHINGTON

SURVEY OF THE ENGINEERING PROFESSION

Undertaken at the Request of the American Engineering Council

1. STATE ..... NAME .....
(Optional. Requested only to aid editing in case of error)

2. CITY ..... BUSINESS ADDRESS, IF ANY .....
(Otherwise home address)

3. YEAR OF BIRTH .....

4. ARE YOU MARRIED? YES ..... NO ..... NUMBER OF DEPENDENTS .....
(Including wife, if married)

5. EDUCATION:	NUMBER OF YEARS ATTENDED	NAME OF INSTITUTION	COURSE TAKEN (e. g. civil engineering, liberal arts, etc.)	DATE OF GRADUATION
a. Secondary schools (1) (High or preparatory)				
b. Noncollegiate technical schools (2) (Day or evening, beyond secondary schools)				
c. University or college (3)				
d. Graduate work (4)				

(Detach Here and Return Questionnaire Only)

6. EMPLOYMENT: The Bureau is tracing the change in engineering opportunities since 1929. Please indicate your major occupation by using a check in the appropriate space to indicate an affirmative answer to describe your status at the END of each of the THREE years.	End of year— 1934	1932	1929
a. Were you engaged in engineering in a private firm or organization? (1) (Excluding private consulting work and teaching)			
b. Were you engaged in engineering on private consulting work?			
(1) As independent consultant (2)			
(2) As employee of private consulting firm (3)			
c. Were you engaged in engineering as an employee of a public authority (excluding work relief)?			
(1) Federal Government (4)			
(2) State Government (5)			
(3) County Government (6)			
(4) Municipal Government (7)			
(5) Other public authority (please specify) (8)			
d. Were you teaching engineering subjects as a member of an engineering faculty? (9)			
e. Were you employed on nonengineering work? (10) (Including teaching other than that indicated under (*d*), but excluding direct relief or work relief) Specify nature of work			
f. Were you on work relief? (11) (Specify relief agency and nature of work)			
g. Any other employment (please specify) (12)			
h. Were you wholly unemployed? (13)			
i. Were you on direct relief (excluding work relief)? (14)			

7. UNEMPLOYMENT AND RELIEF (during 60 months from Jan. 1, 1930, to Dec. 31, 1934):

a. Number of months totally unemployed (1) ..... If none please check here .....
(Excluding months on work relief or C. W. A.)

b. Number of months on work relief or C. W. A. (2) ..... If none please check here .....

c. Number of months on direct relief (3) ..... If none please check here .....
(Excluding months on work relief or C. W. A.)

(1) 16—30057

8. EARNED INCOME (please give data for each year):

	From salaries or personal services in both engineering and nonengineering work	*Average monthly rate from engineering work for time actually employed*
a. For year ending December 31, 1934.....(1)..	.....	.....
b. For year ending December 31, 1932.....(2)..	.....	.....
c. For year ending December 31, 1929.....(3)..	.....	.....

9. HAVE YOU EVER BEEN A MEMBER OF AN ENGINEERING OR ALLIED TECHNICAL SOCIETY?

	Name of society	*Now a member*	*Formerly a member*
National societies.....	.....	.....	.....
	.....		
State societies.....	.....	.....	.....
	.....		
Local societies.....	.....	.....	.....
	.....		

Answer questions 10, 11, 12, 13, and 14 only if you had an engineering job at the end of 1934

10. EMPLOYMENT CONTRACT:

a. Are you under contract for your position? (1) Yes ..... No ..... For what period? .....
b. In the event of separation does your contract require a waiting period before taking similar work? (2) Yes ..... No ..... How many months? .....
c. Have you the right to patent or to receive special compensation for inventions and improvements?
(1) Made in the course of your work (3).....
(2) Not directly related to your work (4).....
d. Have you pension privileges? (5)..... Contributory ..... Noncontributory .....
e. Are you under civil service? (6).....

11. SOURCE OF INFORMATION USED TO LOCATE PRESENT POSITION (please check media used):

a. ..... (1) Engineering society.
b. ..... (2) Private employment agency.
c. ..... (3) United States Employment or Reemployment Service.
d. ..... (4) Other public employment service (specify) .....
e. ..... (5) Personal contacts and recommendations.
f. ..... (6) Newspapers.
g. ..... (7) Technical journals.
h. ..... (8) Any other medium.

12. At the end of 1934, in what industry, service, or zone of interest were you employed? (See "Industry, Service, or Zone of Interest" on opposite page—Classification I.)

.....
(Answer here, as "Public Utilities—Gas")

13. What principal function did you perform in that work? (See "Functional Classification" on opposite page—Classification II.)

.....
(Answer here, as "Operation—Testing")

14. What was your professional classification as an engineer? (Mechanical, civil, electrical, mining, metallurgical, chemical, marine, industrial (not otherwise classified), agricultural, military, naval architect, etc.)

.....
(Answer here, as "Chemical")

CLASSIFICATION I

INDUSTRY, SERVICE, OR ZONE OF INTEREST
(to help in answering question 12)

A. Construction such as—
- Agriculture
- Airport
- Bridges
- Buildings
- Communication
- Heating
- Highways
- Mapping
- Military
- Power
- Railroad
- Reclamation
- Refrigeration
- Regional planning
- Sewerage
- Surveying
- Tunnels
- Ventilation
- Waterways
- Waterworks
- General construction

B. Extractive Industries such as—
- Coal
- Copper
- Iron and steel
- Gold and silver
- Lead and zinc
- Other metals
- Oil and gas
- Nonmetallic minerals

C. Public Utilities such as—
- Electric light and power
- Gas
- Steam
- Cable
- Radio
- Telegraph
- Telephone

D. Transportation Industries such as—
- Steam railroad
- Electric railway
- Water-borne
- Automotive
- Aeronautical
- Pipe line

E. Manufacturing Industries such as—

Iron and Steel:
Machinery, machine tools, vehicles, shipbuilding, aircraft, ordnance, etc.

Electrical Manufacturing:
Power equipment, transmission equipment, motors, lighting, heating, instruments, appliances, etc.

Nonferrous Metal Working:
Copper and alloys, enamelware, etc.

Chemical and Allied Industries:
Charcoal and coke, explosives, paint and varnish, petroleum refineries and products, soap and other chemical products, paper and paper products, etc.

Textiles, Clothing, Boots, and Shoes:
Yarn and cloth manufacture (cotton, wool, silk, rayon, and other fibers) printing and dyeing, garment manufacturing and other textile products-shoe factories, leather products, etc.

Lumber and Furniture:
Lumbering, sawing and planing mills, wood product manufactories, etc.

Food, Drug, Beverage, and Tobacco Industries:
Canning, flour milling, meat packing, sugar refining, other food products, distilleries, breweries, tobacco factories, etc.

Clay, Glass, Tile, and Stone Industries:
Brick, lime and cement, potteries, glass works, etc.

F. Personal Service such as—
- Education
- Publications
- Professional and trade organizations
- Real estate
- Banking
- Insurance
- Wholesale and retail establishments

G. Agriculture and Forestry.

CLASSIFICATION II

FUNCTIONAL CLASSIFICATION
(to help in answering question 13)

A. Design and Research.
Including supervision and administration of Design or Research.
Also include here Exploration, etc.

B. Construction.
Including supervision and administration of Construction.

C. Operation.
Including supervision and administration of Operation.

Also include here Production, Maintenance, Testing, Chemical Analysis and Control, Inspection, etc.

D. Consulting.
Including Investigation, Production, Valuation, Appraisal, Arbitration, Testimony, etc.

E. Teaching.
Including supervision and administration of Education, as Deans, Editors, etc.

F. Sales.
Including supervision and administration of Sales.

G. General Administration and Management.
Including Financial Planning, Organization, Promotion, Efficiency, etc.

Indicate this classification only if not principally or directly supervising or administering one of the other classifications listed above.

16—8087

U. S. DEPARTMENT OF LABOR
BUREAU OF LABOR STATISTICS
WASHINGTON

Dear Sir:

This survey of the engineering profession and the incidence of the depression on engineers is undertaken by the United States Bureau of Labor Statistics at the request of the American Engineering Council, in the hope that the information obtained will be of true service to engineers, and a guide to those who are preparing to enter the profession.

The questionnaire has been prepared with the collaboration of leaders of your profession; the information requested is simple, quickly answered, and vital to the study. The third page is no formidable array of questions, but is a guide to your answers to questions twelve and thirteen. Please answer all questions with the detail requested.

Your answers will be held in strictest confidence, available only to regular sworn employees of this Bureau, for tabulating purposes alone. Your name need not be signed; though we request that it be, so that we may have the opportunity to correspond with you about any apparent errors found in the schedule. The enclosed return envelop requires no postage. Please reply promptly; no schedules can be used which are received after July 8.

The Bureau of Labor Statistics and the societies of your profession will appreciate your cooperation in this venture.

Sincerely yours,

Isador Lubin
Commissioner of Labor Statistics.

(4) U. S. GOVERNMENT PRINTING OFFICE 14—8027

Appendix B

TABLE 1.—*Allocation of engineers in minor professional classes*[1] *with allied major professional classes*

Professional class reported	Total	Combined with—			
		Agricultural	Civil	Electrical	Mechanical
Total	3,605	19	1,583	583	1,420
Administrative	11				11
Aeronautical	224				224
Automotive	91				91
Bridge	23		23		
Combustion	24				24
Commercial	31				31
Communications	62		62		
Construction	121		121		
Electro-chemical	21			21	
Fire protection	41		41		
Forestry	12	12			
Fuel	9				9
Gas	25				25
General engineering	127				127
Geological	88		88		
Geophysical	41		41		
Heating and ventilating	131				131
Highway	258		258		
Hydraulic	86		86		
Hydroelectric	20		20		
Irrigation	13		13		
Lighting	42			42	
Logging	5	5			
Lubrication	20				20
Marine	129				129
Military	70		70		
Miscellaneous	149				149
Municipal	12		12		
Naval Constr., arch	153				153
Ordnance	6		6		
Petroleum	224		224		
Power	13		13		
Production	43				43
Radio	439			439	
Radio broadcast	3			3	
Radio tube	11			11	
Railroad	22		22		
Railway, mechanical	3				3
Railway, electrical	5			5	
Refrigeration	62				62
Research	52				52
Safety	16		16		
Sales engineering	42				42
Sanitary	142		142		
Soil erosion	2	2			
Sound engineering	24		24		
Structural	247		247		
Telephone	62			62	
Textile	81				81
Topographic	9		9		
Valuation	45		45		
Welding	13				13

[1] The number of certain professional classes reported being so small, special analyses are not warranted. Hence, they have been combined with one or another of the major professional classes, as used for the general analyses of the data, to which they are most closely allied.

Appendix C

TABLE 1.—*Distribution of all engineering graduates with course same as professional class reported at end of 1934, by year of graduation*

Course taken	Graduating classes	Total	Professional class								
			Agricultural	Architectural	Ceramic	Chemical	Civil	Electrical	Industrial	Mechanical	Mining and metallurgical
Total engineering graduates with course same as professional class.		36,969	244	359	326	2,951	13,004	9,222	420	8,915	1,528
First degree in engineering, total		34,242	201	338	294	2,488	12,302	8,460	403	8,390	1,366
	1930–34	15,412	84	213	145	1,753	4,436	4,274	294	3,739	474
	1925–29	4,967	45	40	73	204	1,819	1,378	63	1,219	126
	1920–24	3,838	22	26	36	176	1,429	957	22	1,010	160
	1915–19	2,395	27	17	15	107	991	518	11	604	105
	1910–14	2,816	13	26	14	123	1,340	539	3	594	164
	1905–9	2,345	6	7	8	64	1,124	434	4	530	168
	1900–4	1,198	2	3	3	36	518	203	4	336	93
	(1)	1,271	2	6		25	645	157	2	358	76
Engineering only, total		33,098	200	329	289	2,385	11,884	8,165	389	8,174	1,283
	1930–34	15,194	84	211	144	1,724	4,380	4,206	288	3,695	462
	1925–29	4,734	45	37	70	182	1,741	1,310	58	1,173	118
	1920–24	3,687	22	26	36	164	1,380	916	20	979	144
	1915–19	2,287	26	16	15	97	955	487	11	584	96
	1910–14	2,697	13	25	14	10	91,281	516	3	581	155
	1905–9	2,224	6	6	8	58	1,067	408	4	511	156
	1900–4	1,100	2	2	2	30	477	187	3	315	82
	(1)	1,175	2	6		21	603	135	2	336	70
Engineering, plus B. A. in liberal arts, total.		1,000	1	9	4	89	376	245	13	197	66
	1930–34	202		2		28	54	62	6	39	11
	1925–29	209		3	3	21	70	57	5	44	6
	1920–24	120				8	41	30	1	27	13
	1915–19	93	1	1		7	33	26		19	6
	1910–14	98		1		12	48	17		13	7
	1905–9	111		1		6	55	23		16	10
	1900–4	83		1	1	4	37	13	1	19	7
	(1)	84				3	38	17		20	6
Engineering, plus M. A. in liberal arts, total.		86			1	6	33	26	1	14	5
	1930–34	12			1	1	2	2		5	1
	1925–29	11					7	4			
	1920–24	19				1	7	7	1	3	
	1915–19	10				2	3	3		1	1
	1910–14	13				1	7	3			2
	1905–9	9					2	3		3	1
	1900–4	5				1	2	1		1	
	(1)	7					3	3		1	
Engineering, plus Ph. D. in liberal arts, total.		58				8	9	24		5	12
	1930–34	4						4			
	1925–29	13				1	1	7		2	2
	1920–24	12				3	1	4		1	3
	1915–19	5				1		2			2
	1910–14	8				1	4	3			
	1905–9	1									1
	1900–4	10				1	2	2		1	4
	(1)	5				1	1	2		1	

[1] Prior to 1900.

TABLE 1.—*Distribution of all engineering graduates with course same as professional class reported at end of 1934, by year of graduation*—Continued

Course taken	Graduating classes	Total	Professional class								
			Agricultural	Architectural	Ceramic	Chemical	Civil	Electrical	Industrial	Mechanical	Mining and metallurgical
Master's degree in engineering, total		2,477	42	21	30	363	680	699	15	483	144
	1930–34	916	10	10	14	182	180	277	8	181	54
	1925–29	540	11	7	9	73	149	172	3	90	26
	1920–24	327	10		2	46	97	88	3	66	15
	1915–19	191	8	1	3	24	51	55		40	9
	1910–14	207	2	2	2	17	77	49	1	42	15
	1905–9	133	1			6	49	34		33	10
	1900–4	75		1		6	36	13		12	7
	(1)	88				9	41	11		19	8
Engineering only, total		2,448	42	21	30	360	672	690	13	479	141
	1930–34	911	10	10	14	182	180	275	7	181	52
	1925–29	530	11	7	9	73	145	168	3	88	26
	1920–24	321	10		2	44	95	87	2	66	15
	1915–19	190	8	1	3	24	51	55		39	9
	1910–14	203	2	2	2	16	76	48	1	41	15
	1905–9	131	1			6	48	34		33	9
	1900–4	75		1		6	36	13		12	7
	(1)	87				9	41	10		19	8
Engineering, plus B. A. in liberal arts, total.		29				3	8	9	2	4	3
	1930–34	5						2	1		2
	1925–29	10					4	4		2	
	1920–24	6				2	2	1	1		
	1915–19	1								1	
	1910–14	4				1	1	1		1	
	1905–9	2					1				1
	1900–4										
	(1)	1						1			
Doctor's degree in engineering, total		250	1		2	100	22	63	2	42	18
	1930–34	31			1	13	2	7		6	2
	1925–29	51			1	21	6	16		3	4
	1920–24	54	1			21	3	14	1	9	5
	1915–19	28				9	3	6	1	6	3
	1910–14	25				14		6		4	1
	1905–9	23				10	2	6		3	2
	1900–4	13				5	1	3		3	1
	(1)	25				7	5	5		8	

[1] Prior to 1900.

TABLE 2.—*Distribution of all engineering graduates with course different from professional class reported at end of 1934, by year of graduation*

Course taken	Graduating classes	Total	Professional class								
			Agricultural	Architectural	Ceramic	Chemical	Civil	Electrical	Industrial	Mechanical	Mining and metallurgical
Total engineering graduates with course different from professional class.		4,413	111	39	20	144	1,657	362	361	1,441	278
First degree in engineering, total		4,109	97	38	15	121	1,572	333	343	1,356	234
	1930–34	1,547	38	7	3	53	644	82	163	479	78
	1925–29	560	15	4		15	187	54	56	206	23
	1920–24	522	8	7	7	15	215	56	36	140	38
	1915–19	372	5	4	3	6	122	50	23	135	24
	1910–14	372	11	8	1	15	122	31	23	146	15
	1905–9	337	12	4	1	8	125	33	25	110	19
	1900–4	218	5	2		4	87	14	9	77	20
	(1)	181	3	2		5	70	13	8	63	17
Engineering only, total		3,963	92	38	14	117	1,521	322	332	1,309	218
	1930–34	1,532	38	7	3	53	638	81	161	474	77
	1925–29	537	15	4		14	185	54	53	190	22
	1920–24	499	6	7	7	14	206	53	34	135	37
	1915–19	353	5	4	2	6	116	48	19	131	22
	1910–14	353	11	8	1	13	115	30	23	141	11
	1905–9	315	11	4	1	8	115	30	25	104	17
	1900–4	204	4	2		4	80	14	9	75	16
	(1)	170	2	2		5	66	12	8	59	16
Engineering, plus B. A. in liberal arts, total.		128	4		1	4	49	10	10	38	12
	1930–34	15					6	1	2	5	1
	1925–29	20				1	2		3	14	
	1920–24	20	1			1	9	2	2	5	
	1915–19	16			1		6	2	3	3	1
	1910–14	16				2	7	1		3	3
	1905–9	21	1				9	3		6	2
	1900–4	12	1				6			1	4
	(1)	8	1				4	1		1	1
Engineering, plus M. A. in liberal arts, total.		11	1				1		1	6	2
	1930–34										
	1925–29	2								2	
	1920–24	2	1								1
	1915–19	2							1	1	
	1910–14	2								1	1
	1905–9	1					1				
	1900–4										
	(1)	2								2	
Engineering, plus Ph. D. in liberal arts, total.		7					1	1		3	2
	1930–34										
	1925–29	1									1
	1920–24	1						1			
	1915–19	1									1
	1910–14	1								1	
	1905–9										
	1900–4	2					1			1	
	(1)	1								1	
Master's degree in engineering, total		264	14	1	5	19	75	25	15	79	31
	1930–34	66	3		1	8	18	3	8	21	4
	1925–29	62	4		2	5	17	7	2	17	8
	1920–24	45	1	1	1	1	20	5	1	11	4
	1915–19	35	4		1	2	6	4	3	8	7
	1910–14	20	1			2	3	1		9	4
	1905–9	17				1	4	2	1	5	4
	1900–4	12					7			5	
	(1)	7	1					3		3	
Engineering only, total		256	14	1	5	18	73	24	15	75	31
	1930–34	65	3		1	8	18	3	8	20	4
	1925–29	58	4		2	5	15	7	2	15	8
	1920–24	44	1	1	1		20	5	1	11	4
	1915–19	34	4		1	2	6	3	3	8	7
	1910–14	20	1			2	3	1		9	4
	1905–9	17				1	4	2	1	5	4
	1900–4	11					7			4	
	(1)	7	1					3		3	

[1] Prior to 1900.

TABLE 2.—*Distribution of all engineering graduates with course different from professional class reported at end of 1934, by year of graduation*—Continued

Course taken	Graduating classes	Total	Professional class								
			Agricultural	Architectural	Ceramic	Chemical	Civil	Electrical	Industrial	Mechanical	Mining and metallurgical
Engineering, plus B. A. in liberal arts, total.		8				1	2	1		4	
	1930–34	1								1	
	1925–29	4					2			2	
	1920–24	1				1					
	1915–19	1						1			
	1910–14										
	1905–9										
	1900–4	1								1	
	[1]										
Doctor's degree in engineering, total		40				4	10	4	3	6	13
	1930–34	5				1	1			1	2
	1925–29	9				2		1	2	1	3
	1920–24	7					4	2			1
	1915–19	6					2		1		3
	1910–14	5					2				3
	1905–9	5				1		1		3	
	1900–4	1									1
	[1]	2					1			1	

[1] Prior to 1900.

Appendix D

TABLE 1.—*Number of enrollments and first-degree graduations from engineering colleges, 1920 to 1934* [1]

Professional class	Enrollments and number of first degrees							
	1919–20	1921–22	1923–24	1925–26	1927–28	1929–30	1931–32	1933–34
	Total enrollment							
All classes	51,908	56,649	57,690	59,315	66,637	74,000	73,766	62,601
Chemical	5,743	5,364	4,141	4,238	4,948	4,474	8,738	7,222
Civil	8,859	9,672	10,024	10,829	11,501	11,563	11,049	8,391
Electrical	9,469	12,374	14,002	15,666	15,781	15,647	14,903	11,372
Mechanical	11,789	12,154	10,637	9,743	10,434	11,597	13,445	11,485
All others	16,048	17,085	18,886	18,839	23,973	30,719	25,631	24,131
	Number of first degrees							
All classes	4,620	7,358	7,984	7,977	8,284	8,947	10,374	11,421
Chemica	732	1,009	835	741	702	818	1,148	1,359
Civil	1,093	1,615	1,748	1,866	1,874	1,977	2,100	2,036
Electrical	931	1,490	2,047	2,246	2,565	2,427	2,480	2,558
Mechanical	1,238	1,673	2,055	1,809	1,622	1,674	2,085	2,454
All others	626	1,571	1,299	1,315	1,521	2,051	2,561	3,013

[1] Figures derived from the Biennial Surveys of the Office of Education for the years shown.

Appendix E

TABLE 1.—*Distribution of all engineers reporting gross [1] unemployment 1930 to 1934, by type of education and professional class*

Type of education and professional class	Total [2]			Number whose unemployment and work relief was—								
	Number reporting unemployment	Percentage of grand total	Median period in months	Under 6 months	6 and under 12 months	12 and under 18 months	18 and under 24 months	24 and under 30 months	30 and under 36 months	36 and under 42 months	42 and under 48 months	Over 48 months
Total graduate engineers [3]	11,367	33.9	12.2	2,810	2,805	1,891	1,313	895	641	459	273	280
Graduating classes in—												
1933–34	3,489	47.1	7.5	1,438	1,217	452	210	66	28	30	17	31
1930–32	5,902	53.5	11.9	1,431	1,558	1,129	691	429	291	194	94	85
1925–29	2,340	36.0	12.1	560	601	453	313	186	94	75	38	20
1915–24	2,245	27.1	13.4	523	514	362	255	211	164	99	68	49
1905–14	1,570	23.8	17.8	278	294	220	217	179	137	113	58	74
Prior to 1905	810	23.5	23.1	104	95	116	106	86	97	67	57	82
Chemical and ceramic [3]	733	29.2	9.8	229	219	114	74	29	24	19	11	14
Graduating classes in—												
1933–34	397	40.3	7.0	174	141	49	25	3	1	1	1	2
1930–32	555	44.3	10.6	150	166	94	56	28	26	21	7	7
1925–29	132	29.8	11.1	34	37	22	18	6	5	5	3	2
Prior to 1925	154	15.1	11.4	43	38	25	18	8	6	4	4	8
Civil, agricultural, and architectural [3]	4,950	38.0	12.8	1,184	1,181	858	582	407	283	197	125	133
Graduating classes in—												
1933–34	1,212	55.1	7.9	472	418	164	92	28	11	9	8	10
1930–32	2,147	59.7	11.9	532	550	421	261	147	104	68	32	32
1925–29	1,007	41.9	12.2	226	270	205	128	91	37	31	13	6
1915–24	1,114	34.4	12.9	270	260	186	117	102	74	45	31	29
1905–14	832	26.8	17.0	157	152	129	121	89	68	47	27	42
Prior to 1905	422	27.0	22.9	60	45	64	51	43	50	38	35	36
Electrical [3]	2,343	31.6	12.1	574	589	403	269	184	125	93	58	48
Graduating classes in—												
1933–34	878	48.9	7.7	346	319	123	44	14	7	10	3	12
1930–32	1,610	54.7	13.2	330	411	319	199	133	94	62	36	26
1925–29	534	31.3	12.4	139	121	107	75	42	23	13	9	5
1915–24	362	19.6	14.1	84	76	59	40	37	25	17	15	9
1905–14	202	17.2	20.7	56	43	20	27	29	20	22	10	5
Prior to 1905	79	17.1	25.3	8	7	10	13	7	10	7	6	11
Mechanical and industrial [3]	2,685	31.9	12.1	719	703	441	334	231	175	126	73	63
Graduating classes in—												
1933–34	892	40.7	7.1	391	309	102	43	20	8	9	5	5
1930–32	1,379	48.5	11.1	362	382	255	151	101	59	35	16	18
1925–29	598	34.2	12.0	148	151	109	79	43	24	24	13	7
1915–24	576	25.4	15.2	119	123	85	80	60	53	27	19	10
1905–14	384	24.7	18.5	67	72	49	48	44	39	35	17	13
Prior to 1905	242	23.3	22.2	32	33	31	36	27	28	19	14	22
Mining and metallurgical [3]	476	30.2	13.7	104	113	75	54	44	34	24	6	22
Graduating classes in—												
1933–34	110	45.6	6.0	55	30	14	6	1	1	1	0	2
1930–32	211	54.7	11.9	57	49	40	24	20	8	8	3	2
1925–29	69	33.7	11.7	13	22	10	13	4	5	2	0	0
Prior to 1925	258	23.9	17.4	39	54	40	27	30	25	18	5	20

See footnotes at end of table.

TABLE 1.—*Distribution of all engineers reporting gross unemployment 1930 to 1934, by type of education and professional class*—Continued

Type of education and professional class	Total			Number whose unemployment and work relief was—								
	Number reporting unemployment	Percentage of grand total	Median period in months	Under 6 months	6 and under 12 months	12 and under 18 months	18 and under 24 months	24 and under 30 months	30 and under 36 months	36 and under 42 months	42 and under 48 months	Over 48 months
Total college work, incomplete	2,002	35.4	16.3	416	358	319	281	213	157	117	60	81
Born in years—												
1910–14	103	47.9	12.5	24	26	17	13	10	4	4	2	3
1905–9	367	49.5	14.0	81	80	66	53	39	18	17	5	8
1900–4	357	39.0	14.2	79	80	54	52	33	28	14	7	10
1895–99	298	33.4	14.6	66	61	50	33	36	25	13	8	6
Prior to 1895	877	30.4	19.4	166	111	132	130	95	82	69	38	54
Civil engineers [4]	1,182	39.1	15.8	270	205	182	182	108	89	63	34	49
Born in years—												
1910–14	52	55.9	13.8	12	11	10	7	6	3	1	2	0
1905–9	209	57.3	13.9	49	45	34	37	19	10	9	2	4
1900–4	199	43.5	13.2	48	46	27	28	16	16	9	3	6
1895–99	164	37.8	14.1	37	35	28	18	16	16	8	2	4
Prior to 1895	558	33.3	18.3	124	68	83	92	51	44	36	25	35
Mechanical engineers [5]	820	31.2	16.9	146	153	137	99	105	68	54	26	32
Born in years—												
1910–14	51	41.8	11.4	12	15	7	6	4	1	3	0	3
1905–9	158	42.0	14.3	32	35	32	16	20	8	8	3	4
1900–4	158	34.4	15.1	31	34	27	24	17	12	5	4	4
1895–99	134	29.3	15.3	29	26	22	15	20	9	5	6	2
Prior to 1895	319	26.3	22.0	42	43	49	38	44	38	33	13	19
Noncollegiate technical school [5]	955	35.6	17.3	148	202	143	127	90	90	73	28	54
Born in years—												
1910–14	27	48.2	15.0	8	4	3	3	3	3	0	1	2
1905–9	112	49.8	15.3	18	28	18	20	10	10	3	2	3
1900–4	149	41.4	16.0	24	32	28	20	10	11	14	5	5
1895–99	131	34.1	14.7	25	32	19	11	11	16	10	4	3
Prior to 1895	536	32.3	19.2	73	106	75	73	56	50	46	16	41
Total secondary school [6]	219	22.6	12.4	50	58	24	28	15	17	15	4	8

[1] Includes direct relief and work relief.
[2] The United States totals for graduate engineers have been adjusted as explained on p. 34.
[3] Includes gross unemployment figures for first-degree engineering graduates, postgraduates, and on-engineering graduates combined.
[4] Includes agricultural and architectural engineers.
[5] Includes ceramic, chemical, electrical, industrial, and mining and metallurgical engineers.
[6] Includes all professional classes combined.

TABLE 2.—*Distribution of all engineers reporting net [1] unemployment 1930 to 1934, by type of education and professional class*

Type of education and professional class	Total [2]			Number whose reported unemployment was—								
	Number reporting unemployment	Percentage of grand total	Median period in months	Under 6 months	6 and under 12 months	12 and under 18 months	18 and under 24 months	24 and under 30 months	30 and under 36 months	36 and under 42 months	42 and under 48 months	Over 48 months
Total postgraduates [3]	691	27.1	10.9	188	194	125	69	50	30	16	11	8
Graduating classes in—												
1933–34	65	33.9	6.1	32	25	5	1	0	1	1	0	0
1930–32	396	47.2	9.3	132	120	73	38	17	8	6	1	1
1925–29	217	32.4	11.6	53	60	45	27	17	9	5	1	0
1915–24	143	20.1	11.8	36	37	24	13	14	10	3	4	2
Prior to 1915	114	16.7	13.9	22	29	19	11	11	7	5	5	5
Total nonengineering graduates [3]	182	17.8	10.3	54	52	38	16	5	12	3	1	1
Total first-degree engineering graduates [3]	9,876	32.9	11.3	2,575	2,680	1,746	1,051	703	464	321	163	173
Graduating classes in—												
1933–34	3,081	43.0	6.9	1,391	1,084	338	126	51	23	27	24	17
1930–32	5,183	51.4	11.4	1,287	1,458	1,062	544	332	225	159	63	53
1925–29	2,003	35.3	10.9	528	583	398	235	125	65	42	16	11
1915–24	1,952	26.7	11.6	494	513	352	220	154	106	57	30	26
1905–14	1,369	23.1	15.8	239	299	233	180	159	100	78	37	44
Prior to 1905	683	22.8	22.6	59	97	107	102	83	79	57	39	60
Chemical and ceramic	575	29.7	9.6	186	171	89	57	21	20	13	7	11
Graduating classes in—												
1933–34	367	39.4	6.4	176	124	41	18	3	1	1	2	1
1930–32	458	43.5	11.0	115	137	84	49	25	20	17	6	5
1925–29	85	27.3	10.8	21	27	14	10	4	5	2	0	2
Prior to 1925	104	15.0	12.4	29	22	16	16	4	5	3	3	6
Civil, agricultural, and architectural	4,260	35.7	11.3	1,106	1,166	791	456	285	189	127	67	73
Graduating classes in—												
1933–34	1,012	47.2	6.8	459	358	110	41	17	7	5	12	3
1930–32	1,891	56.1	10.8	515	536	410	178	96	77	44	21	14
1925–29	868	40.0	10.5	227	277	175	93	51	23	15	6	1
1915–24	969	33.0	11.2	255	267	176	107	72	46	20	11	15
1905–14	722	25.3	14.9	139	156	137	103	68	42	36	16	25
Prior to 1905	340	24.8	22.3	28	47	59	50	41	39	33	19	24
Electrical engineers	2,057	31.1	11.4	513	568	363	220	157	89	66	38	33
Graduating classes in—												
1933–34	783	45.3	7.4	325	289	93	33	11	7	11	4	10
1930–32	1,422	52.7	13.0	276	384	297	174	112	73	58	26	22
1925–29	459	31.1	11.5	123	117	94	61	35	12	9	6	2
1915–24	318	19.7	11.9	80	80	56	31	26	22	9	8	6
1905–14	182	17.3	17.2	24	47	23	21	29	12	11	4	2
Prior to 1905	69	17.3	25.3	4	11	8	10	7	9	5	6	9
Mechanical and industrial	2,593	31.6	11.4	688	677	429	280	206	132	95	44	42
Graduating classes in—												
1933–34	824	38.5	6.6	382	287	84	29	19	7	9	5	2
1930–32	1,237	47.0	10.8	333	360	236	124	85	48	31	9	11
1925–29	541	34.5	11.0	149	145	101	64	33	24	15	4	6
1915–24	526	25.7	13.1	121	125	96	68	49	30	22	10	5
1905–14	344	24.4	16.6	58	73	53	39	49	29	24	10	9
Prior to 1905	215	22.8	22.0	25	31	29	37	26	23	15	13	16
Mining and metallurgical	391	29.3	13.3	82	98	74	38	34	24	20	7	14
Graduating classes in—												
1933–34	95	41.7	5.8	49	26	10	5	1	1	1	1	1
1930–32	175	53.4	11.8	48	41	35	19	14	7	9	1	1
1925–29	50	33.3	12.0	8	17	14	7	2	1	1	0	0
Prior to 1925	215	23.3	16.4	29	50	39	20	25	19	14	6	13

See footnotes at end of table.

TABLE 2.—*Distribution of all engineers reporting net unemployment 1930 to 1934, by type of education and professional class*—Continued

Type of education and professional class	Total [2]			Number whose reported unemployment was—								
	Number reporting unemployment	Percentage of grand total	Median period in months	Under 6 months	6 and under 12 months	12 and under 18 months	18 and under 24 months	24 and under 30 months	30 and under 36 months	36 and under 42 months	42 and under 48 months	Over 48 months
Total college work incomplete	1,841	32.6	14.2	381	422	326	246	170	119	91	45	41
Born in years—												
1910–14	93	43.3	11.2	23	27	19	7	5	4	4	2	2
1905–9	339	45.7	11.6	75	101	65	40	26	14	10	3	5
1900–4	331	36.1	11.6	78	94	54	49	19	22	7	2	6
1895–99	279	31.3	12.9	63	68	56	31	26	16	15	3	1
Prior to 1895	799	27.7	17.7	142	132	132	119	94	63	55	35	27
Civil engineers [4]	1,054	34.8	13.1	240	253	190	143	81	57	45	26	19
Born in years—												
1910–14	46	49.5	11.2	10	15	9	3	3	4	0	2	0
1905–9	186	51.0	10.8	41	65	35	22	11	5	5	1	1
1900–4	177	38.7	11.1	47	49	27	27	9	11	4	0	3
1895–99	150	34.6	11.8	38	38	31	13	11	8	8	2	1
Prior to 1895	495	29.5	15.9	104	86	88	78	47	29	28	21	14
Mechanical engineers [5]	787	30.0	15.7	141	169	136	103	89	62	46	19	22
Born in years—												
1910–14	47	38.5	11.3	13	12	10	4	2	0	4	0	2
1905–9	153	40.7	13.3	34	36	30	18	15	9	5	2	4
1900–4	154	33.6	12.2	31	45	27	22	10	11	3	2	3
1895–99	129	28.2	14.3	25	30	25	18	15	8	7	1	0
Prior to 1895	304	25.1	21.5	38	46	44	41	47	34	27	14	13
Total noncollegiate technical school [6]	885	33.0	15.7	139	202	164	113	86	71	53	24	33
Born in years—												
1910–14	25	44.6	13.0	6	6	3	2	2	3	0	1	12
1905–9	103	45.8	13.4	21	26	20	16	7	8	2	2	5
1900–4	142	39.4	14.3	27	31	34	13	12	8	13	2	1
1895–99	121	31.5	13.3	26	30	21	11	11	11	6	2	2
Prior to 1895	494	29.8	17.5	59	109	86	71	54	41	32	17	23
Secondary school, [6] United States	205	21.2	11.5	48	59	20	30	15	14	13	2	4

[1] Without regard to direct relief or work relief reported.
[2] The United States totals for graduate engineers have been adjusted as explained on p. 34.
[3] Includes all professional classes.
[4] Includes agricultural and architectural engineers.
[5] Includes ceramic, chemical, electrical, industrial, and mining and metallurgical engineers.
[6] Includes all professional classes combined.

TABLE 3.—*Number of graduate engineers reporting unemployment, and work relief after specified unemployment, 1930 to 1934, by year of graduation*

Year of graduation	Number whose reported unemployment and work relief (in months) was—							
	Under 6	6 and under 12	12 and under 18	18 and under 24	24 and under 30	30 and under 36	36 and under 42	42 and under 48
All engineers with college degrees obtained prior to 1930:								
Total unemployed	6,611	5,136	3,492	2,285	1,485	919	532	282
Total securing work relief	284	479	439	312	222	169	96	53
Civil, agricultural, and architectural:								
Total unemployed	3,133	2,422	1,621	1,027	653	398	236	126
Total securing work relief	187	289	254	184	118	88	50	31
1925–29								
Total unemployed	952	705	409	213	111	50	24	8
Total securing work relief	60	97	71	55	28	13	8	5
1915–24								
Total unemployed	1,035	757	472	282	172	95	47	26
Total securing work relief	75	102	92	59	34	34	13	7
1905–14								
Total unemployed	766	616	450	308	200	128	81	43
Total securing work relief	45	68	65	51	38	20	18	10
Prior to 1905								
Total unemployed	380	344	290	224	170	125	84	49
Total securing work relief	7	22	26	19	18	21	11	9
Other professional classes:								
Total unemployed	3,478	2,714	1,871	1,258	832	521	296	156
Total securing work relief	97	190	185	128	104	81	46	22
1925–29								
Total unemployed	1,309	961	604	348	185	102	51	20
Total securing work relief	33	71	64	39	25	20	10	4
1915–24								
Total unemployed	1,095	828	555	362	287	145	75	36
Total securing work relief	41	62	69	46	28	28	15	3
1905–14								
Total unemployed	709	594	436	328	243	150	87	43
Total securing work relief	20	42	37	30	37	21	9	8
Prior to 1905								
Total unemployed	365	331	276	220	167	124	83	57
Total securing work relief	3	15	15	13	14	12	12	7

Appendix F

TABLE 1.—*Distribution of gross [1] number of all engineers combined reporting annual earnings in 1929, 1932, and 1934 from all types of employment, by age*

[Without regard to employment status or type of education reported]

Year of graduation	1929	1927–28	1925–26	1921–24	1917–20	1913–16	1905–12	1897–1904	1889–96	[2]
Year of birth	1906	1904–5	1902–3	1898–1901	1894–97	1890–93	1882–89	1874–81	1886–73	[2]
Age in years	23	24–25	26–27	28–31	32–35	36–39	40–47	48–55	56–63	64+
Class interval	Number reporting in 1929									
Total reporting earnings	1,518	2,723	2,760	5,131	3,345	3,702	6,618	2,943	1,036	257
Under $800	254	54	18	34	14	19	37	24	16	9
$800 and under $1,000	307	34	16	11	7	2	14	9	8	5
$1,000 and under $1,200	147	47	24	11	10	10	21	9	9	1
$1,200 and under $1,400	90	81	33	29	9	9	16	20	10	3
$1,400 and under $1,600	135	183	72	42	21	13	31	23	12	1
$1,600 and under $1,800	93	231	85	47	17	12	15	12	4	2
$1,800 and under $2,000	184	470	210	150	44	32	56	30	14	9
$2,000 and under $2,200	127	533	311	292	87	64	103	39	21	4
$2,200 and under $2,400	45	254	265	214	72	58	63	21	15	3
$2,400 and under $2,600	54	321	460	543	225	186	227	101	35	20
$2,600 and under $3,000	33	223	474	817	325	257	380	122	45	7
$3,000 and under $3,400	24	161	414	1,039	551	501	686	283	74	17
$3,400 and under $3,800	8	54	185	642	424	408	663	241	76	14
$3,800 and under $4,200	3	26	57	377	315	349	497	184	65	21
$4,200 and under $4,600	1	11	51	306	284	338	515	216	57	22
$4,600 and under $5,000	5	8	16	130	166	179	397	173	62	8
$5,000 and under $5,400	2	12	25	140	177	243	502	213	56	14
$5,400 and under $6,000	2	3	8	78	110	144	321	135	44	5
$6,000 and under $6,600	-------	10	16	101	176	287	532	257	96	22
$6,600 and under $7,200	-------	-------	7	36	62	98	176	108	36	10
$7,200 and under $7,800	2	1	3	23	72	109	247	115	45	10
$7,800 and under $8,400	-------	3	2	19	43	61	153	74	36	4
$8,400 and under $9,000	-------	-------	2	6	20	41	97	47	11	4
$9,000 and under $9,600	1	-------	1	11	23	52	107	72	20	7
$9,600 and under $10,200	-------	1	1	15	39	70	192	84	27	14
$10,200 and under $12,000	-------	-------	-------	3	9	33	94	44	23	2
$12,000 and under $13,800	-------	-------	-------	7	14	54	181	96	37	3
$13,800 and under $15,600	-------	-------	-------	3	7	25	109	68	15	5
$15,600 and under $17,400	-------	1	3	-------	3	11	33	18	12	1
$17,400 and under $19,200	-------	-------	-------	1	4	10	40	19	9	3
$19,200 and over	1	1	1	4	15	27	113	86	46	7

See footnotes at end of table.

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TABLE 1.—*Distribution of gross number of all engineers combined reporting annual earnings in 1929, 1932, and 1934 from all types of employment, by age*—Continued

Year of graduation	1932	1931	1930	1929	1927–28	1925–26	1921–24	1917–20	1913–16	1905–12	1897–1904	1889–96	(2)
Year of birth	1909	1908	1907	1906	1904–5	1902–3	1898–1901	1894–97	1890–93	1882–89	1874–81	1866–73	(3)
Age in years	23	24	25	26	27–28	29–30	31–34	35–38	39–42	43–50	51–58	59–66	67+
Class interval	Number reporting in 1932												
Total reporting earnings	1,799	2,937	3,089	1,654	2,659	2,630	4,889	3,184	3,506	6,178	2,695	931	231
Under $800	104	801	428	180	228	161	273	153	136	291	175	80	17
$800 and under $1,000	177	297	236	84	100	53	95	58	45	83	44	16	8
$1,000 and under $1,200	110	322	248	106	86	89	101	53	65	108	45	22	6
$1,200 and under $1,400	112	402	319	123	140	94	139	70	74	130	57	15	5
$1,400 and under $1,600	82	374	449	163	213	125	164	52	78	120	52	22	8
$1,600 and under $1,800	44	258	380	199	196	123	129	60	53	76	26	9	1
$1,800 and under $2,000	53	237	524	302	332	256	279	131	95	158	76	18	8
$2,000 and under $2,200	28	123	282	223	346	281	342	146	127	228	92	27	9
$2,200 and under $2,400	18	40	69	85	286	234	273	136	115	141	38	10	6
$2,400 and under $2,600	20	36	79	93	259	347	519	241	236	348	110	44	12
$2,600 and under $3,000	11	22	39	43	224	320	680	338	306	428	158	49	9
$3,000 and under $3,400	8	11	20	32	144	276	697	456	440	691	246	58	19
$3,400 and under $3,800	4	5	6	8	46	116	412	319	320	525	215	70	12
$3,800 and under $4,200	2	-----	5	5	19	62	255	222	286	474	170	64	13
$4,200 and under $4,600	3	-----	1	3	15	36	194	195	259	394	163	57	15
$4,600 and under $5,000	-----	-----	-----	1	6	13	94	105	152	283	124	39	4
$5,000 and under $5,400	-----	-----	1	-----	7	16	74	112	154	324	142	52	15
$5,400 and under $6,000	1	-----	-----	1	3	6	42	94	115	234	150	27	7
$6,000 and under $6,600	1	1	-----	-----	5	13	57	84	151	297	172	69	15
$6,600 and under $7,200	-----	1	-----	-----	1	3	15	43	62	139	60	25	8
$7,200 and under $7,800	-----	1	-----	1	1	-----	21	34	58	143	61	30	4
$7,800 and under $8,400	-----	-----	-----	-----	1	2	9	18	40	98	54	26	6
$8,400 and under $9,000	-----	2	-----	-----	-----	2	-----	8	16	57	27	8	1
$9,000 and under $9,600	-----	1	-----	-----	-----	-----	5	10	22	65	40	17	7
$9,600 and under $10,200	-----	2	-----	-----	-----	-----	7	17	38	92	56	9	4
$10,200 and under $12,000	-----	-----	-----	-----	1	-----	4	1	13	51	31	10	2
$12,000 and under $13,800	-----	-----	-----	1	-----	-----	4	12	23	88	43	8	1
$13,800 and under $15,600	-----	-----	-----	-----	-----	-----	2	6	12	42	19	15	1
$15,600 and under $17,400	-----	-----	-----	-----	-----	1	-----	2	2	15	11	4	2
$17,400 and under $19,200	-----	-----	-----	-----	-----	1	1	1	5	17	9	5	2
$19,200 and over	-----	1	3	1	-----	-----	2	7	8	38	29	16	4

See footnotes at end of table.

TABLE 1.—*Distribution of gross number of all engineers combined reporting annual earnings in 1929, 1932, and 1934 from all types of employment, by age*—Continued

Year of graduation	1934	1933	1932	1931	1930	1929	1927–28	1925–26	1921–24	1917–20	1913–16	1905–12	1897–1904	1889–96	(1)
Year of birth	1911–14	1910	1909	1908	1907	1906	1904–5	1902–3	1898–1901	1894–97	1890–93	1882–89	1874–81	1866–73	(2)
Age in years	20–23	24	25	26	27	28	29–30	31–32	33–36	37–40	41–44	45–52	53–60	61–68	69+
Class interval	Number reporting in 1934														
Total reporting earnings	2,826	3,549	3,733	3,626	3,367	1,741	2,806	2,737	5,058	3,275	3,619	3,416	2,819	972	246
Under $800	1,891	853	603	460	277	100	168	116	174	102	103	237	176	101	25
$800 and under $1,000	361	510	454	312	185	75	80	46	79	41	49	87	54	32	7
$1,000 and under $1,200	198	594	573	403	277	105	107	72	119	63	61	115	66	29	8
$1,200 and under $1,400	170	591	627	523	367	127	191	105	169	86	96	167	73	25	18
$1,400 and under $1,600	83	421	599	556	428	180	185	156	230	112	116	172	88	35	10
$1,600 and under $1,800	31	224	311	430	451	199	232	165	190	82	101	133	53	21	4
$1,800 and under $2,000	31	161	254	456	579	291	398	280	384	179	160	262	107	23	9
$2,000 and under $2,200	19	93	147	248	379	282	366	302	391	178	185	269	106	24	9
$2,200 and under $2,400	8	33	49	88	148	116	270	268	354	176	120	198	81	17	4
$2,400 and under $2,600	8	30	48	78	125	110	323	333	520	281	257	429	137	39	11
$2,600 and under $3,000	7	16	29	37	78	72	204	350	628	358	339	490	180	44	9
$3,000 and under $3,400	8	10	17	20	40	45	158	245	666	438	422	683	235	71	26
$3,400 and under $3,800	3	3	7	5	16	18	47	105	366	283	328	517	210	62	9
$3,800 and under $4,200	1		2	1	4	8	33	70	256	202	243	425	167	57	18
$4,200 and under $4,600	1	1	4		3	3	18	53	179	175	223	403	168	58	13
$4,600 and under $5,000		2	1	1	4	2	8	20	103	105	143	293	115	39	4
$5,000 and under $5,400	1	3	1	1	2	2	5	15	68	103	154	290	149	43	11
$5,400 and under $6,000	1	1	2		1	1	1	9	50	81	114	197	126	40	7
$6,000 and under $6,600	3			3		2	7	11	46	82	127	279	149	47	14
$6,600 and under $7,200				1				1	16	43	50	123	46	26	3
$7,200 and under $7,800		1	1	2		2		4	24	21	54	126	59	19	9
$7,800 and under $8,400		1	1					4	18	18	29	85	41	16	3
$8,400 and under $9,000		1	1					3	5	15	15	49	25	10	
$9,000 and under $9,600	1		1	1			1	1	8	12	25	69	32	16	3
$9,600 and under $10,200							2		3	14	30	85	47	17	4
$10,200 and under $12,000							1		2	4	21	62	34	16	2
$12,000 and under $13,800			1			1	1	2	7	8	21	67	41	11	1
$13,800 and under $15,600								1	1	4	13	40	22	4	
$15,600 and under $17,400									1	2	3	12	7	1	
$17,400 and under $19,200										3	3	12	4	5	1
$19,200 and over					3				1	4	14	40	21	14	4

[1] Total number of engineers who reported monthly engineering earnings in any 1 year, irrespective of whether or not they reported in other years.
[2] Prior to 1889.
[3] Prior to 1866.

Appendix G

TABLE 1.—*Distribution of number of engineers reporting monthly engineering earnings in 1929, 1932, and 1934*

[Figures adjusted as explained on p. 34]

Class interval	Total			Chemical and ceramic engineers			Civil, agricultural, and architectural engineers			Electrical engineers			Mechanical and industrial engineers			Mining and metallurgical engineers		
	1929	1932	1934	1929	1932	1934	1929	1932	1934	1929	1932	1934	1929	1932	1934	1929	1932	1934
Total reporting earnings	28,511	28,642	32,836	1,288	1,473	1,958	12,920	12,889	14,624	5,504	5,687	6,222	7,568	7,411	8,648	1,231	1,182	1,384
Under $60	79	439	391	3	21	24	39	224	154	16	69	78	19	105	120	2	20	15
$60 and under $80	49	275	393	4	16	40	25	115	111	7	52	101	11	77	130	2	15	11
$80 and under $100	91	656	1,171	3	47	117	42	253	353	19	144	262	22	192	391	5	20	48
$100 and under $120	326	1,232	2,214	19	78	202	113	515	837	100	246	431	89	344	657	5	49	87
$120 and under $140	786	1,603	2,722	33	93	198	265	643	1,282	277	350	462	199	462	682	12	55	98
$140 and under $160	1,399	2,331	3,387	84	131	179	605	1,076	1,785	347	509	536	317	536	763	46	79	124
$160 and under $180	1,176	1,784	2,383	37	70	108	566	869	1,220	261	361	416	273	434	570	39	50	69
$180 and under $200	1,626	2,034	2,516	58	77	98	826	1,066	1,268	334	429	492	368	407	582	40	55	76
$200 and under $240	4,355	4,520	4,862	152	172	207	2,281	2,320	2,435	821	854	912	947	1,024	1,147	154	150	161
$240 and under $280	3,559	3,238	3,138	124	112	130	1,829	1,629	1,548	650	608	563	839	773	766	117	116	131
$280 and under $320	3,455	2,650	2,243	113	124	114	1,701	1,230	1,086	572	502	478	910	685	651	159	109	114
$320 and under $360	2,565	2,025	1,821	94	100	108	1,254	893	777	461	364	360	656	574	487	100	94	89
$360 and under $400	1,150	1,003	1,050	68	64	64	491	403	413	216	234	227	332	246	291	43	56	55
$400 and under $440	2,014	1,310	1,222	107	88	94	833	491	453	355	224	221	607	428	381	112	79	73
$440 and under $480	779	600	531	47	45	42	298	232	180	156	115	107	239	168	167	39	40	35
$480 and under $520	1,362	817	689	80	50	52	519	297	209	230	144	142	448	272	228	85	54	58
$520 and under $560	450	309	311	34	30	20	159	103	95	79	80	85	145	82	94	33	14	17
$560 and under $600	300	232	188	20	16	17	89	73	50	78	52	39	96	77	73	17	14	9
$600 and under $640	602	340	285	42	21	26	223	110	74	98	73	61	200	114	98	39	22	26
$640 and under $680	316	200	156	15	24	18	124	58	41	50	38	31	110	71	61	17	9	5
$680 and under $760	465	270	257	34	23	22	137	73	72	107	75	61	159	87	81	28	12	21
$760 and under $840	439	247	227	31	21	23	134	73	59	68	46	48	171	84	81	35	23	16
$840 and under $920	134	73	75	7	5	8	44	20	16	28	15	15	52	28	29	3	5	7
$920 and under $1,000	77	52	59	5	5	8	21	11	6	19	18	18	28	12	21	4	6	6
$1,000 and under $1,080	306	128	126	25	11	14	99	40	41	52	24	24	107	46	39	23	7	8
$1,080 and under $1,240	116	73	60	13	6	6	32	17	13	24	19	17	31	27	19	16	4	5
$1,240 and under $1,400	191	71	57	16	11	9	61	18	14	22	12	11	74	22	16	18	8	7
$1,400 and under $1,560	102	44	25	6	4	4	38	10	7	14	10	7	37	15	4	7	5	3
$1,560 and under $1,720	51	22	20	6	1	1	17	9	8	7	3	3	16	5	6	5	4	2
$1,720 and under $1,880	23	8	12	2	1	1	7	2	5	5	2	4	8	2	2	1	1	-------
$1,880 and over	168	56	45	6	6	4	48	16	12	31	15	10	58	12	11	25	7	8

TABLE 2.—*Distribution of gross [1] number of all engineers combined reporting monthly engineering earnings in 1929, 1932, and 1934, by age*

[Without regard to employment status or specific type of education reported]

Year of graduation	1929	1927–28	1925–26	1921–24	1917–20	1913–16	1905–12	1897–1904	1889–96	[2]
Year of birth	1906	1904–5	1902–3	1898–1901	1894–97	1890–93	1882–89	1874–81	1866–73	[2]
Age in years	23	24–25	26–27	28–31	32–35	36–39	40–47	48–55	56–63	64+
Class interval	Number reporting in 1929									
Total reporting earnings	1,446	2,638	2,645	4,905	3,186	3,484	6,233	2,766	970	235
Under $60	10	9	6	11	10	7	4	11	8	3
$60 and under $80	7	5	4	8	5	4	9	2	3	2
$80 and under $100	29	18	11	5	5	3	8	5	6	1
$100 and under $120	135	73	21	26	13	10	26	12	7	3
$120 and under $140	355	240	74	34	16	12	27	15	11	1
$140 and under $160	425	517	196	116	36	24	47	26	7	5
$160 and under $180	177	427	236	171	48	33	57	17	5	5
$180 and under $200	116	479	378	328	102	82	79	38	18	5
$200 and under $240	126	555	858	1,212	443	384	500	187	65	25
$240 and under $280	36	178	438	991	527	428	620	247	78	15
$280 and under $320	12	71	238	842	526	528	824	307	86	20
$320 and under $360	4	29	80	485	431	480	689	261	83	22
$360 and under $400	-------	3	27	161	182	192	365	154	49	15
$400 and under $440	6	18	31	222	274	331	722	296	96	17
$440 and under $480	2	2	12	74	91	143	289	122	38	7
$480 and under $520	-------	9	16	97	163	253	481	249	79	15
$520 and under $560	1	2	3	25	56	82	161	77	34	9
$560 and under $600	-------	-------	3	18	32	58	103	61	19	6
$600 and under $640	-------	-------	3	19	68	110	221	119	50	11
$640 and under $680	-------	1	2	14	33	43	129	60	32	2
$680 and under $760	1	-------	2	14	42	76	180	109	29	12
$760 and under $840	1	2	1	16	36	69	188	80	31	14
$840 and under $920	-------	-------	-------	2	10	22	55	32	10	2
$920 and under $1,000	-------	-------	-------	-------	4	12	33	15	12	1
$1,000 and under 1,080	1	-------	2	4	10	39	143	78	27	2
$1,080 and under $1,240	-------	-------	-------	2	5	11	55	26	14	3
$1,240 and under $1,400	-------	-------	1	1	4	21	87	59	17	2
$1,400 and under $1,560	-------	-------	1	1	5	11	41	25	14	3
$1,560 and under $1,720	-------	-------	-------	-------	-------	1	21	21	6	2
$1,720 and under $1,880	1	-------	-------	-------	1	1	9	7	4	-------
$1,880 and over	1	-------	1	6	8	14	60	48	32	5

See footnotes at end of table.

TABLE 2.—*Distribution of gross number of all engineers combined reporting monthly engineering earnings in 1929, 1932, and 1934, by age*—Continued

Year of graduation	1932	1931	1930	1929	1927–28	1925–26	1921–24	1917–20	1913–16	1905–12	1897–1904	1889–96	(3)
Year of birth	1909	1908	1907	1906	1904–5	1902–3	1898–1901	1894–97	1890–93	1882–89	1874–81	1866–73	(3)
Age in years	23	24	25	26	27–28	29–30	31–34	35–38	39–42	43–50	51–58	59–66	67+
Class interval	Number reporting in 1932												
Total reporting earnings	1,050	2,044	2,506	1,419	2,389	2,395	4,433	2,907	3,175	5,620	2,431	837	201
Under $60	80	76	45	19	32	27	49	28	32	78	41	27	5
$60 and under $80	89	79	45	15	27	16	27	16	17	28	14	5	2
$80 and under $100	206	259	147	56	52	37	59	36	30	44	23	12	1
$100 and under $120	264	467	330	106	135	75	109	64	40	113	41	12	4
$120 and under $140	173	478	574	234	227	116	154	55	65	85	34	12	7
$140 and under $160	124	388	729	360	373	253	261	106	88	52	74	27	6
$160 and under $180	35	143	315	231	326	256	278	102	95	146	72	16	9
$180 and under $200	20	54	144	170	436	331	366	175	158	192	58	23	7
$200 and under $240	36	74	131	167	499	650	1,085	513	461	672	242	74	23
$240 and under $280	13	14	23	36	166	317	766	454	440	710	245	61	18
$280 and under $320	4	5	11	12	64	166	524	424	424	678	257	79	13
$320 and under $360	1	-----	6	6	22	80	331	285	361	605	224	89	20
$360 and under $400	2	-----	-----	3	10	21	132	145	189	312	135	45	11
$400 and under $440	-----	-----	-----	-----	11	20	122	181	219	482	200	62	13
$440 and under $480	1	-----	-----	-----	1	8	45	70	101	205	135	30	5
$480 and under $520	-----	-----	1	1	4	11	46	84	147	276	176	58	14
$520 and under $560	-----	-----	-----	-----	1	3	14	33	58	107	55	32	6
$560 and under $600	-----	-----	-----	-----	1	2	9	25	43	88	42	7	5
$600 and under $640	2	1	-----	-----	1	2	20	36	47	141	55	31	5
$640 and under $680	-----	-----	-----	-----	-----	1	10	15	28	80	42	21	3
$680 and under $760	-----	2	1	-----	-----	2	5	16	38	108	69	23	7
$760 and under $840	-----	2	-----	1	-----	1	8	18	38	96	55	23	7
$840 and under $920	-----	-----	-----	-----	-----	-----	2	5	8	30	21	7	-----
$920 and under $1,000	-----	-----	-----	-----	-----	-----	2	-----	4	26	13	6	1
$1,000 and under $1,080	-----	-----	1	-----	-----	-----	3	9	17	56	36	6	1
$1,080 and under $1,240	-----	1	-----	-----	-----	-----	2	3	8	34	17	8	1
$1,240 and under $1,400	-----	-----	1	-----	-----	-----	1	4	8	29	19	9	1
$1,400 and under $1,560	-----	-----	-----	1	1	-----	-----	1	3	19	12	6	3
$1,560 and under $1,720	-----	-----	-----	-----	-----	-----	-----	2	2	9	3	4	-----
$1,720 and under $1,880	-----	-----	2	-----	-----	-----	1	-----	-----	1	3	3	-----
$1,880 and over	-----	1	-----	1	-----	-----	2	2	6	18	18	9	3

See footnotes at end of table.

TABLE 2.—*Distribution of gross number of all engineers combined reporting monthly engineering earnings in 1929, 1932, and 1934, by age*—Continued

Year of graduation	1934	1933	1932	1931	1930	1929	1927–28	1925–26	1921–24	1917–20	1913–16	1905–12	1897–1904	1889–96	(2)
Year of birth	1911–14	1910	1909	1908	1907	1906	1904–5	1902–3	1898–1901	1894–97	1890–93	1882–89	1874–81	1866–73	(3)
Age in years	20–23	24	25	26	27	28	29–30	31–38	33–36	37–40	41–44	45–52	53–60	61–68	69+
Class interval	Number reporting in 1934														
Total reporting earnings	2,054	2,500	2,602	2,635	2,618	1,477	2,483	2,454	4,549	2,985	3,290	5,808	2,554	857	216
Under $60	69	68	64	47	28	11	25	17	29	20	29	51	38	20	8
$60 and under $80	180	127	121	58	33	21	13	11	22	11	10	26	16	5	4
$80 and under $100	481	474	390	225	135	42	54	32	42	24	21	57	29	19	5
$100 and under $120	614	714	602	486	336	114	177	78	119	61	65	129	51	31	11
$120 and under $140	426	556	665	603	483	204	242	161	250	112	108	174	77	35	8
$140 and under $160	166	324	423	679	718	320	431	307	382	172	186	240	149	40	11
$160 and under $180	54	110	164	257	396	287	349	248	345	162	161	224	79	28	11
$180 and under $200	24	52	79	143	234	197	385	384	458	215	177	274	118	27	5
$200 and under $240	19	46	57	106	180	191	505	637	1,025	556	534	810	275	72	24
$240 and under $280	4	9	21	14	46	47	168	270	685	447	427	728	253	70	19
$280 and under $320	2	3	4	9	14	23	67	135	479	357	386	626	258	79	18
$320 and under $360		2	4	1	2	9	30	82	302	250	297	543	209	76	20
$360 and under $400	1	1	2		4	1	16	34	116	152	182	330	159	50	9
$400 and under $440	1	2	2	1	4	4	7	25	127	148	210	444	184	55	12
$440 and under $480		1	1		1	2	1	5	42	67	93	174	110	36	3
$480 and under $520	1	1	1	1		2	6	15	40	81	121	221	146	45	12
$520 and under $560							1		15	33	54	122	54	24	8
$560 and under $600				1					7	27	36	67	32	17	2
$600 and under $640								2	22	17	46	117	54	19	9
$640 and under $680	2							3	13	12	20	59	30	14	4
$680 and under $760	3	2	1	2			2	4	13	24	28	104	54	24	3
$760 and under $840	3	5	1			1	1	1	2	16	37	91	52	21	4
$840 and under $920	2	2			1				4	1	8	28	23	11	
$920 and under $1,000										1	9	30	13	4	2
$1,000 and under $1,080	2						1	2	5	8	20	47	32	11	
$1,080 and under $1,240				1				1	2	2	5	27	23	2	
$1,240 and under $1,400		1		1			1		1	4	9	26	13	3	
$1,400 and under $1,560									1	2	1	10	5	6	
$1,560 and under $1,720							1			1	2	6	3	4	3
$1,720 and under $1,880					1						1	7	2	2	
$1,880 and over					2	1			1	2	7	16	13	7	1

[1] Total number of engineers who reported monthly engineering earnings in any 1 year, irrespective of whether or not they reported in other years.
[2] Prior to 1889.
[3] Prior to 1866.